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THE MARSEILLES HYDROELECTRIC PLANT.

A transmission plant somewhat out of the ordinary in the design of the generating units is that belonging to the McKinley system of northern Illinois and located at Marseilles, on the Illinois River. This plant, first put into operation last October, supplies energy to 125 miles of interurban railway and half a dozen small electric lighting systems. Its striking feature lies in the fact that, being developed on only 11 ft. head, all that was available for regular service, it was found desirable to follow lines of design not commonly used in this country, and instead of pursuing the old practice of gearing several wheels together upon a single generator the slow-running umbrella type of machine is used, mounted directly on the vertical turbine shaft. Half a dozen old wheels and some generating equipment inherited from an earlier plant were remounted in the old-fashioned way, but the six new units, each consisting of a 320-kva generator and a 74-in. vertical-shaft turbine, are of the new design. The scheme is a familiar one, best known perhaps in this country for its utilization in the Niagara plant, but often used, particularly on the Continent, at low heads. The rotor of the generators is 10 ft. in diameter, and its weight, together with that of the turbine runner and shaft, is carried in suspension from an oil-lubricated roller bearing at the top of the shaft. The construction is such as to give singularly easy access to both the turbine and generator for repairs. The speed of the unit is only 75 r.p.m., and each individual wheel is regulated by a separate hydraulic governor, all the governors in turn being operated from the switchboard.

Another interesting feature is that a 20-ton electric crane arranged to run the entire length of the building is especially fitted for operating steel emergency headgates fitted to cut off the water supply from any independent turbine flume. The transmission is at the somewhat conservative voltage of 33,000. Less commonplace, however, are the pole lines, which are of reinforced concrete. The necessities of the distribution have caused the generators to be separated into two groups, one operating at 60 cycles and the other at 25 cycles. Of the vertical-shaft generators four are of 25 cycles for railway service, and one of the horizontal-shaft units is likewise for 25 cycles. The three remaining generators are 60-cycle and devoted to lighting work. A 750-kva frequency changer enables load to be interchanged between these two systems. It is certainly regrettable that engineers should ever have to be driven to splitting the frequency in a single station. It is by no means necessary, although it unfortunately has become the custom, to work generators for railway service at so low frequency that they cannot possibly be used for direct lighting service, and it is earnestly to be hoped that the advances

of the next few years will render such a clumsy subdivision of plant unnecessary. The motor-generators and cascade converters work perfectly well at 60 cycles, and ordinary synchronous converters have been made to give good service at this frequency. Possibly the mercury rectifier may come into play to relieve the situation, but it certainly is lamentable to see stubborn adherence to a double standard of frequency, which, looked at in a large way, is almost as disconcerting as a double monetary standard.

HIGH MELTING POINTS.

The vital point in improvements in incandescent lamps is the possibility of getting material of very high melting point. A recent investigation of the melting points of tungsten and tantalum, the two most important metals for lamp filaments, is of interest as throwing some light on the usefulness of these elements and the possibility of obtaining even more refractory material. The work in question was done at the University of Wisconsin, and seemingly with great care, the measurements being taken, as always in such cases, with the optical pyrometer, but with thorough precautions against sources of error. One of the unusual precautions adopted was to check the usual colored glasses employed in pyrometers by employing a direct-vision prism which enabled one to work with closely monochromatic light. The results obtained for these two metals were in the mean 3002 deg. C. for tungsten and 2798 deg. C. for tantalum. Some previous values have run as high as 3250 for the former and 2700 for the latter. Now, the interesting thing practically about these values is that the difference of melting points between tantalum and tungsten does not sufficiently account for the difference in working efficiency with filaments made respectively of the two materials, nor are there any differences of the nature of selective radiation sufficient to account for the unpleasant practical fact that tantalum cannot be worked as near the efficiency of tungsten as the difference of melting point would indicate. It is, of course, possible that the average commercial tantalum used in filaments is not quite pure, in which case the melting point might very well drop, and also the extraordinary faulting of the filament might perhaps be accounted for. It is certain that the temperature coefficient of the tantalum filament is not such as would ordinarily belong to a pure metal. Another interesting point in the investigation was that in one attempt to melt tantalum it was heated in a graphite furnace up to a point which was certainly above the normal melting point of tantalum, without producing fusion; but when the specimen was removed from the furnace it had entirely changed in appearance, looking, in fact, as if it had probably been attacked by the carbon vapor, forming a compound less fusible than the tantalum itself. An observation of this kind may be of no practical import, but it is at least a hint that it is worth while to look in the case of tantalum and tungsten for possible compounds more refractory than either metal, or at least equally refractory with a higher specific resistance. So little is actually known about the physical properties of these rare though important metals that any side light on their behavior is extremely welcome, and what is disclosed should not be overlooked.

THE HEAT PATHS IN ELECTRICAL MACHINERY.

If we take any well-designed dynamo-electric machine and double all of its linear dimensions in a new unit of the same type, then the new machine will manifestly have four times the external surface of the original and eight times its volume and weight. Therefore, if the new machine is to have the same specific output as the old, expressed, say, in watts per kilogram, and likewise the same percentage of efficiency, the power dissipated in the new machine must be eight times as great as that in the old, and the average dissipation of power per unit of surface will be twice as great in the new machine as in the old. This will require, in general, that the new machine shall have, on the average, twice the surface temperature elevation of the old machine. If, on the other hand, the temperature elevation must be kept alike in both machines, then the output of the new one must be cut down, so as to give only four times the output of the old machine, instead of eight times the output.

In practice, with relatively small machines, the above reasoning is vitiated by the fact that the efficiency rises distinctly as the size of the machine is increased, so that an eightfold increase in weight does not have to dissipate an eightfold increase in heat. But, as we ascend the scale of dimensions in machinery, we come to a point where the efficiency rises but very slightly with further increase in size. Thus the reasoning gets the range of the conditions and begins to open a heavy fire upon the lines of design. In fact, the difficulties of disengaging the wasted power constantly increase as the designer increases the output and size of large machines. Since temperature elevation sets a limitation to output, it is clear that, if the heat wasted in a large machine cannot adequately be removed, the machine will be unnecessarily diminished in its output and rating. Dynamo designers are thus compelled to devote increasing attention to the conditions under which heat is expelled from large generators. A certain relatively small amount of the waste-power heat liberated in a large generator is expelled from it by conduction into the base. In some cases, however, the base of the generator is a steam turbine, at a higher temperature than the generator, so that this conductive escape is shut off. An appreciable amount of the heat liberated in a large generator is expelled by radiation from the surface of the machine, but by far the largest portion of the heat is expelled by convection into the surrounding air. Convection is of two kinds—namely, free convection, due to eddy currents in the otherwise stationary air, and forced convection, due to air movements, or windage. The forced convection is always much more effective than the free convection in expelling heat from the machine. Nevertheless, the laws governing the loss of heat in free and forced convection are very complicated, and the motion of the air through and around the rotor is also irregular and complex.

A useful paper giving the empirical results of a number of thermal measurements and tests of large machines, by Messrs. H. D. Symons and Miles Walker, has recently been read before the British Institution of Electrical Engineers. The data thus provided are very acceptable, albeit expressed in a remarkable mixture of metric and obsolescent units, such as watts per square centimeter, mingled with

cubic feet of air per minute. It would be much easier to adhere to the metric units exclusively. Among the various results of interest noted in the paper is the effect of tight packing of insulating material upon the increased flow of escaping heat. When the insulating material is tightly compressed its thermal conductivity tends to be increased by the exclusion of air, except in the rare cases where the solid insulating substance has a lower thermal conductivity than stationary air.

HIGH-TENSION SYSTEMS AND TELEGRAPH AND TELEPHONE LINES.

Telegraph lines have long been subject to disturbances from neighboring high-tension lines, and even from neighboring telegraph lines on the same poles. The disturbances are of such kinds as mutilate signals and interfere with the telegraph traffic. Altogether, apart from accidental crosses, these disturbances are caused by any or all of three different influences, namely, electric-leakage conductance, electromagnetic induction and electrostatic induction. In the dry climate of North America the disturbing influence of leakage conductance—whereby a current steadily flowing along one wire passes through the pole arms and insulators into neighboring wires—is relatively insignificant; but in some parts of Europe where the climate is intensely humid this source of disturbance is so influential that it becomes necessary to run a ground wire to the bases of all the insulators on each pole, in order to carry directly away to ground all the current that escapes over each insulator from any line wire. As regards electromagnetic and electrostatic disturbances, they are closely commingled in telegraph-line wires, and it is not possible to suppress them completely on such wires employing ground return. It is, however, possible to minimize these disturbances in various ways, such as by breaking up lines into repeating sections, separating them on the cross-arms, or reducing disturbing current strengths, so as to prevent the disturbances from interfering with the traffic.

In the case of telephone wires the disturbances above mentioned would all be increased if ground-return circuits were used, because the telephone receiver is so sensitive an instrument. But by using metallic circuits the disturbances are theoretically capable of being eliminated entirely, and are practically capable of being eliminated to a satisfactory degree, by transposing the wires in each pair. When, however, telegraph or telephone lines are subjected to disturbing influences from high-tension power-transmission lines the problem becomes more serious. As regards conductance, the danger of disturbance is practically negligible if the power wires are supported on a separate line of poles or towers, assuming that there is no chance of the wires falling accidentally into mutual contact. Even when the signaling wires are supported on the same poles as the power-transmission wires there is usually but little danger from conductance of current unless an insulator breaks. There is often a good opportunity for electromagnetic disturbance, but the best opportunity is found for electrostatic disturbance.

Theoretically, when a balanced three-phase high-tension line system is supported symmetrically on poles and telephone metallic circuits are also symmetrically supported on the same or adjacent poles, disturbances to the telephone lines may be eliminated by transposing both the high-tension lines and the telephone lines. Nevertheless, it becomes very difficult to maintain the symmetry of transposition closely enough to suppress the inductive disturbances completely. Moreover, any accidental derangement of the high-tension system, such as an accidental grounding of one wire at a broken insulator, or even an accidental dissymmetry of load, will destroy the balance of a normally perfectly transposed system and produce marked disturbances in the telephone circuits. In practice when telephone circuits are carried between power-transmission stations on the same poles as the power wires a sudden appearance of inductive disturbance in the telephones may be the first indication of some defect that has developed on the power-line system. The electromagnetic disturbance that may be produced on neighboring signaling lines by unbalanced neighboring high-tension lines may be serious, but the electrostatic disturbance can be much worse. Telephone lines running for many kilometers parallel to and several meters removed from a power-transmission line can acquire, in badly unbalanced conditions, pressures to ground measured in hectovolts. That is, a single telephone line, open at each end and supported half-way up on the poles of a high-tension transmission line, may develop an electrostatically induced alternating potential of hundreds of volts, although the system would have to be very badly out of transposition balance in order to produce so large a free potential in the telephone line. However, in such an extreme case it is evident that it would be very dangerous for a person standing on good ground to come into contact with the telephone wire when the power wires above it were in action. Even in cases more likely to present themselves in practice, with a more reasonable approach to normal transposition balance, there might be a distinct danger, both to person and to apparatus, in using the telephone if the power-transmission system were accidentally thrown out of electric symmetry. It therefore becomes necessary to guard telephone circuits running for a long distance in proximity with high-tension lines from insulation break-down, and also to take insulation precautions to protect those who may use the telephones from shock.

An article by Dr. Karl Hohage on this subject, noticed in our *Digest* recently, has lately appeared in the *Elektrotechnische Zeitschrift,* in which special forms of telephone apparatus are described suitable for use in conjunction with high-tension power lines. Ample insulation is provided in this telephone apparatus both for the protection of the person who may use it and for the protection of the apparatus itself against accidental over-voltage induced by neighboring high-tension lines. Long before it becomes necessary to resort to such elaborate means of insulation as the article describes the disturbing influence of high-tension lines on neighboring telephone lines is sure to make itself felt in parasitic noises that render telephonic communication difficult. As in the companionship of the giant and the dwarf it is well for the dwarf to choose a separate path in times of strenuous activity, so it is the tendency of the weak-current signaling system to shrink away from the highways pre-empted by the strong-current power systems.

Memorial to Professor Joubert.

A committee has been formed under the auspices of the Société Internationale des Électriciens to solicit funds with which to endow a scholarship to be named after the late Prof. Jules Joubert. Professor Joubert, who died about a year ago, made the famous pioneer experimental investigation of alternating currents and collaborated with Mascart in writing the well-known treatise on electricity associated with their names, which remains a classic. Another claim to recognition is the aid which Joubert gave to Pasteur in some of his great investigations. The committee includes official representatives from the Société Internationale des Électriciens, the Pasteur Institute, the French Physical Society and the Physicists' Union, and includes practically all of the great names in contemporary French science. The great paper in 1881 of Joubert, giving an experimental study of a Siemens alternator, using the point-to-point method which he originated, laid the foundation upon which practical alternating-current theory has been built, and alone would seem to merit commemoration in the permanent form proposed. Subscriptions may be forwarded to Prof. Paul Janet, director of the Central Laboratory and of the Superior School of Electricity, 14 rue de Staël, Paris.

Reported Plan of Incandescent Lamp Marketing.

At the concluding session of the Electrical Supply Jobbers' Association at Cleveland, as reported in last week's issue, it was decided to hold the next meeting of the association at Atlantic City about the middle of May. In the corridor talk following the adjournment of the Cleveland convention it was revealed that the plan which has been formulated by the manufacturers of incandescent lamps for the distribution of their product is conceived on a basis of conserving and using existing agencies for distribution. The plan is necessarily designed to observe the terms and spirit of the decree in the government suit, which inhibited the control of a resale price. It accordingly provides for the sale of lamps to the consumer under a sales contract in which the distributor becomes a direct representative of the manufacturer.

BANQUET OF THE PITTSBURGH SECTION, A. I. E. E.

The annual banquet of the Pittsburgh Section of the American Institute of Electrical Engineers, held Feb. 17 at the Fort Pitt Hotel, was the largest and most successful ever held by this organization, over 400 members and their friends being present. The speechmaking was started by Mr. K. C. Randall, chairman of the local section, who introduced the toastmaster, Mr. L. A. Osborne, vice-president of the Westinghouse Electric & Manufacturing Company.

The guest of honor and first speaker was President Gano Dunn of the Institute, who responded to the toast "The Electrical Engineer." President Dunn spoke of the wonderful accomplishments of the electrical engineer and paid tribute to Pittsburgh as the engineering city. He said that what it had accomplished was a great monument to engineering. George Washington, a great civil engineer, visited the site of Pittsburgh three times and had the government send out a commission which caused a city to be founded there. The many virtues possessed by the immortal Washington cause us often to forget that first of all he was an engineer and a great one. In closing President Dunn said that the A. I. E. E. is feeling more and more the sense of its own responsibility and it owes its growth to the work of sections like the one in Pittsburgh.

The next speaker was Dr. Hammerschlag, director of the Carnegie Technical Schools, who spoke on the value of an expert in solving general human problems. In the half century since Faraday discovered the principle of induction there have been many changes, and many duties devolve on the educational institutions which serve to encourage the growth of a truer and better life. There is a need for experts, real ones, not theoretical. The training should be so broad and so sure as to make experts think of human value, human lives. Where to get them is the question. On the educational institutions devolves the burden. The A. I. E. E. aids by educating engineers, but co-ordination is needed. Engineers should take part in the settlement of world problems.

Mr. A. Leo Weil, president of the Voters' League of Pittsburgh, an attorney who has been very prominent in the civic improvement of the city, spoke on "The Electrical Development Part in Modern Municipal Conditions." He said that until electrical development became prevalent the city was regarded as a separate and distinct unit apart from human interests, but since the advent of the telegraph, telephone and electric railways, light and power the city has become a co-operative organization and undreamed of values have been realized. In 1902 the value of municipal franchises exceeded in amount the bonded indebtedness of any city. In New York City alone they were valued at $450,000,000 and assessed at more than one-half of this, or more than $100 for every man and woman in the city.

The speaker made an earnest appeal for electric engineers, who have done so much, to do something to counteract the baneful influences so prevalent in many modern civil governments. Engineers are agents of nature, and they should emulate nature in improving civic conditions. Mr. Weil admitted he did not know how, but he had confidence in a body of men that had accomplished so much and he believed they could accomplish anything. He said that no force on earth is greater than that of public opinion and that electrical engineers could influence it.

The last speaker of the evening was Mr. H. E. Longwell, who proved to be the humorist of the occasion. He took for his subject "Cultural Studies and Their Value to the Engineer." Mr. Longwell spoke of the value of Latin and Greek to the engineer and in a humorous vein mentioned many of the dead-language phrases used in engineering parlance.

The arrangements for the banquet were carried to very successful termination by Mr. K. C. Randall, chairman, and Mr. E. L. Farrar, secretary, assisted by the committee consisting of Messrs. R. W. Atkinson, R. V. Bingay, R. S. Feicht, E. Friedlaender, S. P. Grace and E. P. VanKirk.

Electrical Vehicle Club of Boston.

The regular weekly meeting of the Boston Electric Vehicle Club was held on Feb. 14, with President Baker in the chair. Mr. N. Rommelfanger, a prominent electric garage owner in Boston, testified that he felt convinced that a year's service of seven 10 ft. by 20-ft. electrically lighted billboards had been a factor in stimulating the sales of pleasure vehicles handled by his house. It was thought best by the club, in informally considering the matter, to confine its work largely to newspaper publicity for the present. Mr. J. S. Codman, for the committee on an electric garage and sales building, reported that insufficient enthusiasm had been manifested to date to warrant taking up options on sites. President Baker and Mr. Converse D. Marsh, of New York, strongly urged the continuance of the proejct, stating that its realization would be the means of giving the electric vehicle a standing in New England which it has not yet attained. The gasoline-car dealers have laid out large sums on buildings of striking character, and a centralization of electric-vehicle exhibits and sales

agencies appears of too great importance to overlook at the present time. Mr. E. J. Tabb, fire commissioner of the town of Revere, was present and displayed an open mind regarding electric trucks for fire-department service, he being in the market for equipment. A short account was given him of the successful pioneer installations at Springfield, Mass., where it is understood that the total cost of electrical energy for some ten months' service with an average of two outfits has not exceeded $20.

ORNAMENTAL STREET LIGHTING.

Ornamental street lighting was the topic of discussion at the regular weekly meeting on Feb. 16 of the Luncheon Club branch of the New England Section, N. E. L. A., at Boston, the principal speaker being Mr. Harvey S. Tonks, secretary of the Ornamental Lighting Pole Company, of New York. Mr. Tonks emphasized the necessity for spending money in order to earn it, particularly in the illumination of municipalities by mercantile impetus. He described the conspicuous installation lately made in the business district of New Haven, Conn., and outlined the benefits of tasteful lighting in connection with the expansion of retail business and the enhancement of local prestige. He quoted the celebrated Inspector Burns, of McNamara fame, to the effect that if one desires to clean up a slum district, plenty of electric lamps and clean streets are worth more than all the law-and-order societies in existence. Wherever ornamental street lighting has been installed it has stimulated civic pride and commercial development and has been immediately seen to be a public improvement. Mr. Tonks outlined a plan of campaign for ornamental street lighting by the central station in co-operation with the local board of trade, urging that with the lighting company should rest the final decision as to the type and design of lamp and supporting structure to be used, and recommending uniformity of illumination, leadership by friends of the company, the stimulation of local pride in signing front-foot contracts, long-term agreements and prompt action upon a comprehensive plan at the mass meeting or banquet launching the project. Contracts for more than 1200 front-feet were signed at the original meeting in New Haven, and the existing installation yields the local lighting company a revenue corresponding to over $16,000 per mile of thoroughfare illuminated per year. Standardization of designs, neat poles, just enough ornamentation to avoid plainness and the establishment of a basic rate for ornamental street lighting were advised. A slogan, to be announced on the night when the illumination is opened, was commended, and the speaker urged lighting all business thoroughfares from the up-town district to the railroad stations. "Town" signs installed along railroad rights-of-way were highly praised as evidences of progressiveness. A field of useful service exists in connection with the ornamental lighting of private estates and the illumination of sections of cities and towns which are being "boomed" by real estate interests, and of beaches, parks and summer resorts.

In a brief discussion which followed Chairman L. D. Gibbs cited the great improvements brought about in the appearance of the Hanover Street district in Boston. He pointed out that the onus of niggardly illumination rests with the taxpayer and the municipal officers whom he elects to represent him, and not with the central-station organization. He said: "It only remains for us as a bunch of co-operative boosters to get the people out and keep them out, and the police will do the rest!" Closing, Mr. Tonks voiced the opinion that window and sign illuminations are in no sense hampered by the installation of modern ornamental street-lighting service. At the meeting of Feb. 23 the speaker scheduled was Mr. H. W. Moses, manager of the Boston 1912 Electric Show.

SCHENECTADY N. E. L. A. MEETING.

The meeting of the Eastern New York Section of the National Electric Light Association at Schenectady on Feb. 20 was especially noteworthy by reason of the prominence of the speakers, including President John F. Gilchrist of the N. E. L. A., President C. A. Coffin of the General Electric Company and President Samuel Insull of the Commonwealth Edison Company. The chairman of the section, Mr. M. Webb Offutt, formerly vice-president and general manager of the Schenectady Illuminating Company and now with the Electric Bond & Share Company, New York, presided. The chairman presented Mr. Coffin, who explained the immense benefit derived by him from the enthusiasm produced by being associated with the younger generation of electrical engineers, and introduced Mr. Insull, the first speaker of the evening, as an inspiring man who remains always young although one of the pioneers in the central-station industry. Mr. Coffin claimed that the results accomplished by Mr. Insull are so far-reaching and so well known that they speak for themselves.

Mr. Insull remarked that it seemed appropriate to call attention to the boldness and genius of Mr. Thomas A. Edison in establishing the electrical factory at Schenectady, when the old Edison Machine Works were transferred to abandoned locomotive works at that place in 1886. The plot selected contained about ten acres, which seemed enormously extensive for the business in prospect. Mr. Insull discussed at some length the activities of the National Electric Light Association, the business it represents and the advantages conferred upon its membership. The chief business of the association is looking after the interest of its member companies and individual members. This work covers not only commercial and technical features, but also legal actions and systems of accounting. As a result of the work of the association, the business of central stations throughout the country is being standardized along advanced lines. Of the various lines of activity of the association the most important can be considered that concerning the relation of the member companies to the public. The central-station company which does not realize its obligations to the public is doomed to failure. The business of the central station is by nature, and if successful must be, a monopoly; in a sense, it must be conducted as though it were a department of the local government. Success in conducting such a monopoly depends upon obtaining and holding the good-will of the people. With almost no exceptions, it is safe to rely on the common sense and fair dealing of the community, provided a company is sincere in its efforts to cater to the wants of the people. When troubles arise between the public and a company, almost invariably the fault lies with the company rather than with the public.

In order to call attention to the possibilities of development of central-station business, Mr. Insull mentioned a statement recently made by Mr. Edison, that the time will come when the public as such will be unfamiliar with coal. All coal utilized will be consumed in central stations from which energy will be distributed for all lighting, heating and industrial purposes. The proper work for the central station is to supply electrical energy for all possible services. Where such a result is accomplished the lighting load forms only from 15 to 25 per cent of the total load on the station. As an example of well-developed central-station activity, Mr. Insull pointed to Schenectady, where electrical energy is widely used for practically all purposes. The chief advantage to be gained from generating all of the electrical energy in a certain community at one station, rather than in a number of small stations, is attributable to the diversity of load. For instance, in Schenectady it is not possible for the maximum factory load, maximum street-car load and maximum lighting load to occur simultaneously. During factory hours the workmen are utilizing energy for driving motors, when the factory closes use is

made of energy for propelling the cars to convey the workmen to their homes, and later energy is used for illuminating the homes. Thus the same equipment can be used for supplying energy to the factory, the street cars and the homes, without appreciable over-lap in the loads. High station load-factor means low costs and results in a low price for the electrical energy to the consumer and high income to the central station which provides the energy. Unless a central station can be so run as to render the operation of plants utilizing coal in the same neighborhood an economical impossibility, the station is not properly managed.

The possibilities of development of central-station load are enormous. For example, ten years ago the maximum central-station load in Chicago was 20,000 kw; three years ago it was 100,000 kw, and at the present time the maximum load is 200,000 kw. With the electrification of steam-railway terminals in the Chicago neighborhood, which will inevitably be accomplished, the maximum load on the central stations in that neighborhood may reach 1,000,000 kw. Mr. Insull claimed that the time will come when throughout all of the territory east of the Mississippi and north of the Ohio central-station plants will be used for supplying energy to all railways, not only the present city and interurban lines, but also the heavy trunk lines now operated by steam.

Mr. Insull claimed that the chances for the energetic and ambitious young man in electrical work are much greater now than they were thirty years ago. The electrical business has become so well established that no difficulty is now encountered in obtaining capital to finance legitimate undertakings. Success depends largely upon conducting the companies along well-established lines, and is assured for the person who devotes himself to his business with a full realization of his obligations to the community which he serves. Moreover, a man without special collegiate training need not consider himself handicapped, because success depends more largely upon attention to details and personal application to duties at hand than upon special training. This fact is shown in the Commonwealth Edison Company, where every man occupying a position of importance has risen directly from the ranks of the workers in the company.

President Gilchrist, who was introduced by Chairman Offutt as one long identified with the central-station industry, entered an urgent plea for support in the work now being accomplished and projected by the National Electric Light Association. The success of the association will depend largely upon the ability of those in charge to look into the future. Organization for this work is an essential requirement. Although the National Electric Light Association now numbers among its membership from 80 to 90 per cent of the men actively engaged in the central-station industry of the country, yet only 1000 of the 4500 eligible central stations are numbered among its Class A members. This fact appears to be of considerable importance when the status of the association is discussed in legal circles. It is very desirable to enlist the co-operation of all present members in the campaign to increase not only Class B but also Class A membership. President Gilchrist claimed that the reports presented by the committees of the association are of much greater importance and carry greater weight than is ordinarily realized. The fact is that the men selected to prepare these reports are of such high type that if one were called upon to select experts for the compilation of information connecting the different subjects he could not well obtain a better list than that provided by the committees.

The president called particular attention to the forthcoming Seattle convention of the association. Many of the committees making preparations for this convention are at work and have accomplished excellent results. The transportation committee, in particular, has made excellent arrangements for the members from a distance who will attend the convention.

ARTIFICIAL DAYLIGHT.

At the January meeting of the New England Section of the Illuminating Engineering Society a large and enthusiastic attendance enjoyed a symposium upon artificial daylight. Papers were read by Dr. C. H. Sharp and Mr. Preston S. Millar, of New York, on "A Sample of the Practical Use of Tungsten Lamps to Produce Daylight Effects," and by Dr. Louis Bell, Boston, for Dr. H. E. Ives, Cleveland, upon "The Relation Between the Color of the Illuminant and the Color of the Illuminated Object," and an address was given by Mr. R. B. Hussey, Boston, upon recent designs in lamps planned to meet the demand for artificial daylight production.

RELATION BETWEEN COLOR OF ILLUMINANT AND OF ILLUMINATED OBJECTS.

Dr. Ives pointed out that the designer of an artificial daylight for the purposes of color matching must bear in mind the essential differences between the various illuminants, the color composition of natural objects and the nature of possible distortions in appearances produced by the various combinations of these. The author discussed at length the methods of expressing the phenomena of color in equations, pointing out the advantages of measuring color sensations in terms of the co-ordinates of red, green and blue, the values being derived by the air of spectrophotometric measurements. In discussing color schemes it is most convenient to disregard all luminosity differences and place all colors in a single reference triangle. The psychological point was mentioned that after working for a time under artificial light one ceases to note that it is monochromatic. Thus, with the carbon lamp, the yellow light is soon not noticed, and one forms a new scale of color with unsaturated yellow as the white. In this way compensation is introduced for the really enormous changes in color which are experienced. Just how to represent this compensation is a matter probably yet to be determined. Besides the color changes there is a depression of luminosities in the deficient spectral regions of the illuminant, an exaggeration in the excessive regions. These changes may be treated in the way color changes are handled, by using the luminosity curves of the illuminants in conjunction with the distribution of reflecting power in the spectrum of the surface. Two colored surfaces may match under the same colored illumination, where each is under a different illumination, or they may match under one illumination but not under another. That is, two colors may be physiologically alike under one illuminant, but physiologically unlike under another. A true yellow and a red-plus-green-yellow illustrate this point. Examination of two apparently similar colored surfaces with a spectroscope will therefore tell whether their match will hold under all conditions. Constant color appearance is met by restriction to one light source of constant spectral character. This rules out the use of another illuminant with the same integral color. It is possible to make a physiological white by a mixture of monochromatic yellow and blue light. A white surface under this would look as it does under daylight, but hardly a single other color would. It is therefore not sufficient to produce an artificial daylight which measures correctly on a color-mixing instrument; the spectrophotometer is indispensable, although a colorimeter in practice is a valuable adjunct.

In conclusion, Dr. Ives discussed the practical realization of artificial daylight by the subtractive or absorption method. The problem is to combine with an artificial source absorbing media whose transmission is the reciprocal of the spectrophotometric curve of the source as compared with daylight. The practical problem is that of the proper choice of artificial illuminant and of absorbing media, given the previously determined spectrophotometric relationship between the source and daylight. As to the most suitable artificial illuminant to resemble daylight, two desiderata

may be mentioned; first, it should be itself as near daylight in character as possible, so as to reduce to a minimum the loss of light produced by the use of absorbing media; second, its spectrum should be as free as possible from irregularities, such as bright emission bands or dark absorption bands, difficult to eradicate by ordinary absorbing media. As to the latter, two kinds are the most practicable, colored glasses and dyed films, either of gelatine or collodion. Dyes have two disadvantages. Their absorptions are apt to be rather narrow, and they are liable to fade. Colored glasses are subject to the objections that the number of absorptions obtainable is quite limited and that they are not so transparent in their less absorbing parts as are dyed films. They are, however, very permanent, and for that reason should be used to the fullest extent. The practical problem, therefore, becomes one of combining and compromising, using glasses where possible, and supplementing by the most permanent dyes obtainable. An example has been given by the author and Mr. Luckiesh (see *Electrical World,* May 4, 1911). In this the tungsten lamp is screened by a combination of cobalt-blue and signal-green glass in connection with a dye to absorb some transmitted yellow-green light. This combination has of necessity a very low efficiency, since the absorption is chiefly for orange and yellow light, which constitutes the larger part of the luminosity of the tungsten lamp. The compromise with the ideal absorption derived from the spectrophotometric data is, however, small, and where the need is for an artificial daylight for color matching the low luminous efficiency of this type of light may be more than compensated for by its excellence from the standpoint of color.

RECENT EQUIPMENT FOR REALIZING ARTIFICIAL DAYLIGHT.

Mr. Hussey, of the illuminating engineering department of the General Electric Company, emphasized the indefinite qualities of daylight, and the standardization of north light from a clear blue sky as the most representative natural illumination for the work of color matching. The problem of duplicating this is the present issue. Any lamp of the incandescent class will have an excess of the longer wave lengths, such as red and orange, and this will be in some measure an indication of temperature. The higher the temperature the more nearly the approximation to white light. To correct for daylight it is necessary to reduce the proportion of red. Where a large proportion of the energy is concentrated in a few wave-lengths or particular spots in the spectrum, difficulties abound, and as an extreme case it would be practically impossible to correct the mercury lamp to any such standard. A lamp of the flaming-arc or magnetite class, while it has a bright line spectrum, at the same time has the lines so thoroughly distributed that it should not offer any serious difficulties.

From the inclosed carbon arc lamp there is obtained a resultant light which has an excess of red and orange, with slight excess of violet, so that it becomes necessary to reduce at both ends of the spectrum. The problem with the inclosed arc lamp resolves itself into compounding the different absorption media so as to obtain a resultant absorption which will be practically correct. In working out the problem for the inclosed arc lamp all of the different colors of glass obtainable were tried, but none was exactly right. It was possible to get very good color absorption by staining glass, but the absorption was so great that there was very little light left to use. The most flexible arrangement was to place several colors side by side, mixing the resultant light so as to get the desired effect. If the run of glass varied, changes in the proportions of the different colors were made to offset it. The speaker exhibited a lamp built on these principles, and stated that it has found application in the exacting work of textile dye houses.

PRODUCTION OF DAYLIGHT EFFECT BY TUNGSTEN LAMPS.

Dr. Sharp and Mr. Millar described the treatment of a special problem for exhibition-room service, in connection with the illumination of a colored-silk display at Paterson, N. J. Competitive conditions of an emergency character required the establishment of a highly effective installation. The dyed silks to be displayed were in the form of skeins covering all the practicable tints and shades of the entire spectrum, including purple as well. The arrangement was such as to conform to the well-known color circle. By the use of a large number of tints a spectrum was produced which made it necessary that the light thrown upon the skeins should have practically a daylight spectrum and that the appearance of white light should not result from the blending of a few colors only. It was found that the artificial daylight illumination on the silks would have to compare favorably with the illumination provided by a skylight in the hall, since it was the intention to open the exhibition in the daytime as well as at night. It was also evident that the regular illumination of the hall by carbon-filament incandescent lamps and arc lamps might have a very disturbing effect upon the colors of the exhibit. It was laid down as necessary that the illumination on the silks must have a relatively high value, at least 25-ft. candles being aimed at, in order to drown out the effect of other illuminants.

Three cases were to contain the exhibits, two being 92.5 in. by 21.5 in. in dimensions and one 68.5 in. by 21.5 in. All had plate-glass sides, the skeins being arranged in pyramids so that they could be viewed from any side. The angle of the pyramid was such that light falling from above had an angle of incidence of about 60 deg., but an observer looking into the case viewed the silks about normally. The light of the room fell freely upon the silks. The choice of illuminants was rather restricted. The mercury arc, taken with enough incandescents to add the proper red, was ruled out on account of the discontinuous character of the spectrum of the mercury vapor. Other arc lamps were ruled out on account of space limitations. The tungsten lamp remained as the next best choice. The light would have to be passed through color screens to take out the excess of red and yellow, and thus to vary the composition of the transmitted light to a daylight value. Using a preliminary estimate of the amount of light which would be lost in this way, a computation showed that it would be possible to put enough high candle-power tungsten lamps in the space directly over each case to produce the required illumination.

The proper color value and the minimum loss of light were the chief objects in selecting the color screens. Experiments were carried on at the Electrical Testing Laboratories on color screens, but the urgency was so great that the method of comparing artificial daylight with natural daylight by a Lummer-Brodhun photometric cube was employed. Comparisons were made both with the color of direct sunlight and with the light which came from the northern sky. Various materials were tried as screens. With such green and blue glasses as were available it was found to be possible to get a good approximation to daylight, but the quantity of glass readily at hand precluded the use of these. Colored celluloid was unsatisfactory on account of its very indefinite absorption limits. Finally, solutions covered with aniline dyes—that is, the staining solutions used in coloring incandescent bulbs—were tried, and it was found that if a blue staining solution and a green staining solution were used, and each was thinned to the proper consistency, a glass coated 70 per cent on its surface with the blue, 15 per cent with green and with no coating on the remainder served to modify the light of the tungsten lamps and to produce a good match to daylight. The loss of light due to these screens was about 87 per cent. Sheets of ground glass were used in the actual application. The colors were put on in narrow bands, and ground glass was used on account of its diffusing powers, so that at the short distance at which the silks were placed the rays of light which had passed through the different portions of the color screen would be white. The authors used 100-watt clear-bulb tungsten lamps in a concealed orna-

mental box interior on top of the showcases, each lamp being fitted with a prismatic reflector. Lamps rated at about 10 volts below the hall circuit were employed in order to secure an output of 1 candle per watt or better, and improved light. It was necessary to install as many lamps as possible in the boxes in order to overcome the effect of the absorption. Neither the lamps nor the color screens were visible to the ordinary observer. The arrangement produced a very intense illumination of a quality very striking in comparison with that in the rest of the hall. Although under the severe conditions the lamps deteriorated rapidly and the dyes of the color screens faded, the results were satisfactory from the practical side.

Discussion.

Prof. H. E. Clifford touched upon the importance of producing artificial daylight over an area of considerable size. President V. R. Lansingh, of the national society, said that the subject is of increasing importance, as modern department stores take up the question from the commercial standpoint. He suggested that the time is near at hand when a single piece of glass will be manufactured which will have such absorptive values as will give artificial daylight equivalent to the natural kind. The efficiency will probably be higher than in using selective measures. A glass has already been produced in the experimental stage with which a tungsten filament gives practically the same effect as an ordinary blue skylight.

Dr. A. E. Kennelly said that it has become necessary only to indicate how it is possible to imitate at night real daylight color to stimulate designers and inventors to arrive at a practical and economical solution of this important problem, because from the esthetic standpoint alone, without touching the hygienic or color-matching aspects, the value of a light of this kind is enormous. Once it becomes the fashion for stores to produce daylight illumination, the necessity of doing that on a growing scale will be intense. Prof. W. E. Wickenden pointed out that productive activity would be greatly increased with the establishment of artificial daylight conditions. Most of the previous work has resulted in the production of cloudy daylight, particularly in the use of diffusing schemes of illumination and the installation of the carbon-dioxide tube. The value to art museums of solving the problem would be inestimable.

Dr. Louis Bell said that what is needed is an average idea of what daylight really is before attempts are made on a large scale to produce it artificially. He touched upon the early use of a light-blue lamp chimney in connection with kerosene lamps to produce white light from a yellowish flame. He doubted whether any single "standard" of daylight would meet all the needs of retail salesmanship and pointed out that, while the carbon-dioxide tube is a good match for the northern sky in most respects, it shows on very critical examination some weaknesses with particular tones, particularly in the browns. The use of the continuous spectrum for any subtractive purposes is essential. Dr. Bell said that he was inclined to think that the discontinuous sources must be abandoned in favor of either a high-intensity carbon arc or a high-intensity incandescent. The so-called intensified arc suggests an interesting starting point. Mr. Millar referred to the savings which would be possible in building construction if artificial daylight were generally available.

NITROGEN FIXATION IN NORWAY.

At the meeting of the Chicago Section of the American Electrochemical Society on Jan. 5 the subject of nitrogen fixation by the electric arc was discussed by Messrs. L. L. Summers and E. R. Wolcott. Mr. Summers spoke interestingly of work being done on a commercial scale in Norway, bringing out points unnoticed in the usual descriptions. The high heads everywhere available in the Scandinavian peninsula make very cheap water-power possible. Powers are developed at $30 per kw, the interest on which amounts only to about $2 per year, so that energy is commonly sold at $7 per hp-year, twenty-four hours per day. The stations abroad, said Mr. Summers, are splendidly built, commanding the best engineering talent of Europe. Instead, for example, of carrying penstocks or flumes along cliffs, as is the American practice, tunnels are excavated paralleling the sides of the cliffs, about 70 ft. back from the surface, so that flume operation is independent of landslides, weather, etc. These rock tunnels are excavated very cheaply and rapidly by piercing a number of entry shafts from the cliff side to obtain many simultaneous headings. The entry shafts are afterward closed by means of concrete. The famous Notodden plant has a head of 1700 ft. with 70 ft. draw-down, and discharges its tailwater into a stream 500 ft. below the generator floor. The units comprise 20,000-hp water-wheels driving two 8500-kw generators on the same shaft.

On account of the low power-factors and consequent surges of the nitrogen arc furnaces, it has been the practice to run separate single leads all the way from the generators to each furnace electrode. The power-factor of the Birkeland-Eyde furnace is 70 per cent. In this furnace, as is well known, the arc is whipped into a succession of concentric flames by a fixed electromagnetic field. In its competitor, the Schoenherr furnace, 6000-volt arcs of the great length of 20 ft. are formed in rotating air columns in long, hollow pipes. In smaller sizes the Schoenherr furnace was at first found to give higher concentrations, but as the Eyde ovens have been increased in size from 800 kw to 3000 kw, nitrogen contents of practically equivalent value are now obtained. The patents for both furnaces are now owned by the Badische company, and recent installations have been made using both types. From the furnaces the gases, bearing their nitrogenous compounds and at a temperature of 2500 deg., are led through water-tube boilers which provide all the steam needed about the plant. About 40 per cent of the energy of the arcs is reclaimed in this way. After further cooling, the gases are led through three absorption towers, arranged with counterflows of water, the nitric-acid solution density from the last tower being as high as 30 per cent. The remaining unabsorbed nitrogen gases are taken through the alkaline towers, where the last vestiges of nitrogen are converted into nitrates and nitrites, which are separated by crystallization processes. The nitrate, with a nitrogen content of 13½ per cent, is sold in competition with Chile saltpeter containing 15 per cent nitrogen.

At present the yield of such arc furnaces is about 1200 lb. of nitric acid per kw-year. With higher productions the method will become economical even at the greater cost of American hydroelectric energy. A tremendous need for fertilizer material exists in this country, although the requirements of the soil in this direction are better appreciated in Europe than here. If nitric acid be turned on phosphate rock a valuable fertilizer is obtained. This is now largely manufactured in Norway on account of the difficulty of shipping the corrosive acid. Many soils need phosphate replacement as well as nitrogen, so that the phosphate-rock fertilizer is of double value. As a fertilizer, calcium cyanamide, which offers another means for the fixation of atmospheric nitrogen (by passing air over heated carbide that has been produced electrically), is open to the objection of charging the soil with carbon.

Mr. E. R. Wolcott followed with a historical account of the several methods of nitrogen fixation, outlining the arc processes using high-tension, high-current-density and high-frequency discharges. He compared thermal processes with electrical methods and gave figures to show at what efficiencies and concentrations nitrogen fixation by arc furnaces might become profitable in America.

NEW YORK PUBLIC SERVICE COMMISSION REPORTS.

FIRST DISTRICT COMMISSION.

The New York Public Service Commission for the First District states in its annual report that during the year 1911 it awarded subway contracts to the amount of $29,000,000, which, with the contracts awarded in previous years and not yet completed, makes nearly $50,000,000 worth of work now going on. These new contracts are on the Lextington Avenue route, which is a part of the system upon which the commission has been engaged for some time.

The commission urges that the Legislature pass an amendment to the law providing that organized companies must secure the approval of their securities, as is now the case with solvent companies. "Otherwise," the commission adds, "one of the greatest benefits of regulation of securities will have been lost." This recommendation is made in view of the decision of the Court of Appeals in the Third Avenue Railroad case.

The commission also suggests that the Legislature shall consider the advisability of prohibiting the review by certiorari of the orders of the commission. The commission states that writs of certiorari have been obtained in suits now pending by eleven companies to review orders of the commission in four cases.

The commission recommends that a bill be passed providing a method of exempting self-sustaining rapid transit bonds issued after Jan. 1, 1910. Under the constitutional amendment adopted in 1909 the Legislature of 1910 passed a bill providing a method for exempting bonds issued prior to Jan. 1, 1910, and the proposed bill will allow any other issues of bonds to be exempted as they become self-sustaining.

The commission held 715 hearings, at which testimony was taken in the 228 formal proceedings that were before the commission during the year. Of the sixty-two remaining undetermined at the end of the year decisions in a number were postponed at the request of the applicants.

The action of the commission upon applications for stocks and bonds during the year is as follows:

In cases involving applications for approval of securities, other than in the reorganization cases, the aggregate of the requests of the companies was $79,944,177. Of this amount the commission allowed $20,548,819.

There are now ninety-seven operating and lessor transportation corporations subject to the jurisdiction of the commission, with an aggregate capitalization of $1,124,342,471. The number of consumers of electricity, with the total operating revenues of such companies, is: In 1908, number 108,732, total $21,920,243; in 1909, number 128,052, total $23,622,432; in 1910, number 157,458, total $26,021,461.

The commission points out that the per capita expenditure of the public of New York City in 1910 was as follows: $16.35 for transportation, $6.68 for gas and $5.32 for electricity, a total of $28.35, and that the expenses of the commission in supervising such public utilities were $377,000, a per capita expense of 8 cents.

The commission states that there have been organized at one time and another, to operate partly or wholly within the city of New York, 240 railroad companies, 388 street railroad companies, seventy tunnel railroad companies, 199 gas companies and 143 electric companies. Owing to failure to get franchises, leases to other companies and otherwise, the actual number reporting at the present time is as follows: Thirty-two railroad companies, eighty-two street railroad companies, one stage coach company, fifteen electric companies, twenty gas companies and three combined gas and electric companies.

The commission points out that most of the complaints are handled without the necessity of formal procedure. Of these informal cases there were during the year 1740 against railroads and street railroads and 468 against gas and electric companies other than those relating to meters. During the year the commission tested 609 electric meters against which complaint had been made and 409,234 gas meters, of which 4425 were tested upon complaint from the consumers.

SECOND DISTRICT COMMISSION.

A review of the operations and condition of more than 1000 corporations, with a total capitalization of $4,517,718,440, under the jurisdiction of the New York Public Service Commission, Second District, is given in the fifth annual report of the commission. The public-service corporations under the direction of the commission include 124 street railroad corporations, 294 electrical corporations, 143 gas corporations, fifty combined gas and electrical corporations, ten telegraph corporations and 142 telephone corporations.

During 1911 the commission had presented to it 2321 propositions, as against 2059 in 1910, 1845 in 1909 and 1606 in 1908. This makes a total during the four years of the commission's existence of 7831. In 1911 the commission disposed of 258 applications of various kinds, 314 formal complaints, 1593 complaints which were conducted by correspondence and seventy-seven orders to show cause. The total of public hearings given was 572, as against 554 for the year 1910 and 415 for the year 1909. The number of days occupied by hearings was 285, as against 196 in 1910. These cases do not take into account several thousand matters of correspondence between the public and the commission.

Attention is called to the very healthy growth in the total operating revenue of electric street railroads in the Second District. In 1907 this total was $19,293,052, and in 1911 $26,979,399. The net revenues from railroad operations during the same period increased from $6,821,197 to $10,289,682, or 50 per cent. The figures indicate that there has been a steady growth in the operating revenues of the electric railroads for the past five years. The percentage of increase during the last year over the preceding one was 8 per cent. Operating expenses increased 4 per cent and the net revenues from railroad operations for the year were 15.1 per cent greater than for the preceding year. The electric railroads carried during the year 542,695,000 passengers.

For the fifty larger companies selling electricity exclusively the operating income—that is, the gross operating revenues less expenses and taxes—for the year ended Dec. 31, 1910, showed an increase of 28.7 per cent over the preceding year. For the thirty-nine larger companies selling both electricity and gas there was an increase in the corresponding period of 24.6 per cent, while for the fifteen larger companies which engaged in selling gas only there was an increase of 21.7 per cent. The report indicates that while the gas companies are holding their own in the matter of revenues they are not making the same progress as the electrical companies.

The report shows that among electric railroad, electrical and gas corporations 117 are now paying dividends, as against eighty-two in 1910 and against seventy-three in 1909.

During the year the commission authorized the issuance of stock, bonds and other evidences of indebtedness to the amount of $162,581,718.52, as against $151,000,000 in 1910, $142,000,000 in 1909 and $92,000,000 in 1908. The total amount authorized is $566,469,507.86.

The report cites specific instances in which the commission found it advisable to proceed summarily against gas and electrical corporations in matters urgently affecting the security of the public, non-compliance with the law, or disregard of recommendations informally made by the commission respecting conditions which obviously should be

corrected. Proceedings of this character and in the nature of orders to show cause were had against twelve corporations.

Numerous instances are stated of inspections of gas and electrical distribution systems resulting from proceedings before the commission and of examinations made by the commission into the safety of construction and operation of gas and electric plants and distribution systems, and into the quality and adequacy of gas and electric service.

Attention is called to the progress being made as to the necessity of establishing a heat-unit standard for the measurement of gas. The inquiry in New York State is in the hands of a joint committee comprising representatives of the commission and of the gas companies.

The system of electric meter testing and inspection which has been continued during the year includes (1) laboratory tests of various types of electric meters to ascertain their ability to maintain reasonably close accuracy under usual operating conditions; (2) tests of electric meters on the complaint of consumers and on their premises; (3) frequent tests of the instruments used by corporations and municipalities in testing their consumers' meters, and (4) a general supervision of the methods of meter testing and installation employed by the corporations, which includes the filing of monthly meter reports showing the condition of such meters as were tested.

Station-testing standards owned and in use by the companies were tested as follows: 900 rotating standards, 227 indicating wattmeters, 119 voltmeters, 72 ammeters, a total of 1318. Of this total, 1291 were approved as accurate, 27 were disapproved and ordered readjusted, and 49 were recalibrated by the inspectors.

This year 87,893 consumers' meters were tested by the companies, which is 3317 more than were tested last year and 9777 more than were tested in 1909. A percentage of fast meters to the total of 9.5 per cent was found in 1909, 7.4 per cent in 1910, 5.6 per cent in 1911. The percentage of correct meters for these years was 69.9 per cent, 75.2 per cent and 79.8 per cent respectively.

By amendment of the law of 1910 electrical corporations were prohibited from installing any meter the type of which shall not have been approved by the commission. The electrical laboratory was further equipped for this special work, and tests have been completed upon all types of electric meters except the several types of induction meters. Information given by the companies shows that there are over 166,000 electric meters in use in the Second Public Service District, comprising thirty different types.

The commission calls attention to the conduct of municipal lighting plants which are operated in two cities and forty-eight villages of the State. It is stated that such municipal plants are, with a few commendable exceptions, unable or unwilling to adopt practices of modern accounting, and in many instances the bookkeeping is limited to a record of consumers' accounts and a simple statement of receipts and disbursements with little or no attempt at analysis or classification. In some cases the affairs of the lighting plants are so interrelated to those of water or some other departments, and the accounts of the two departments are so confused, that it is impossible to determine the actual results of the operation of either department.

The commission remarks that it is a matter of supreme importance, when municipalities embark upon business enterprises, that they should adopt businesslike methods. The citizens of many a village are convinced that their lighting service is cheap when as a matter of fact it is dear, because the lack of a proper accounting system fails to reveal the actual conditions. The commission finds it is without sufficient force to teach the elementary rules of accounting to the administrative officers of these municipal lighting plants, but it is making a serious effort to accomplish complete and accurate accounting in municipal as well as in privately managed business enterprises, and to show that the extra work and the extra expense incurred will be more than compensated for by the greater knowledge of the business and the economies which can be effected thereby.

As a result of inspection by commission employees a vast number of defects in operating efficiency and methods, as well as of the equipment, lines and apparatus, has been found in telephone plants. During the year 424 central offices serving 372,860 substations have been inspected.

The commission says that it should have sufficient power to ascertain its jurisdiction and to close the door to those evils which will in time inevitably spring up from the legal permission to authorize telephone companies with less than $10,000 of property which will ultimately acquire property above the jurisdictional point without knowledge or authorization of the commission.

Attention is also called to the tendency to consolidation among telephone companies and to the apparent facts that the New York Telephone Company will sooner or later absorb all of the Bell companies existing in the State, and that in the western part of the State the Federal company is assuming the same policy with its subsidiary and affiliated corporations. The Legislature is asked to take measures to correct any evil there may be in this policy.

Before taking up some telephone-rate cases the commission is conducting a thorough examination into all the elements which go to make up such rates.

The commission has submitted as the estimate necessary to carry on its operations during the fiscal year commencing Oct. 1, 1912, $381,927.50, which is a trifle less than was appropriated by the Legislature for the year commencing Oct. 1, 1911.

ST. LOUIS DECISION DISTINGUISHES BETWEEN "FIXING" AND "REGULATING" RATES.

Judge C. C. Allen, of St. Louis, in a decision handed down on Feb. 12, holds that the ordinance passed at the instance of the Public Service Commission of St. Louis, enacting that 9.5 cents shall be the maximum rate for electrical energy sold in that city, is void. The city was enjoined permanently from enforcing the ordinance. The city will appeal the case, however.

The main issue on which the case was decided in the Circuit Court in favor of the Union Electric Light & Power Company rested upon the legal interpretation of the word "fixed" in the Cooper public-service act passed by the Missouri Legislature in 1907. The ordinance forming the basis of the suit was prepared after more than a year's study of the situation by the city authorities and the valuation of the Union Electric properties. It was attacked by the company on several grounds, but the principal issue was on the question whether it harmonized with the wording of the Cooper act.

The law provides that public-utility corporations may charge no more for their utilities than "such rates as shall be fixed from time to time by ordinance by the cities in this State in which such utilities are operated." Cities are given authority to fix by ordinance the rates of charge for the services of such utilities, provided that the rates are reasonable and that they are not changed oftener than once every two years. Under this law, by a city ordinance approved April 12, 1911, it was declared that the maximum rate of the Union Electric Light & Power Company of St. Louis and of the other electric-service companies of that city should be 9.5 cents a kw-hour.

In its motion to have made permanent a temporary injunction to prevent the city from enforcing this ordinance, the electric-service company's attorneys contended that the ordinance in question did not "fix" the rates, but sought to regulate them by a maximum rate, and therefore was not in strict compliance with the state law. The attorneys for the city insisted that this contention was merely a legal quibble

and that the spirit of the St. Louis ordinance was in harmony with the spirit and intention of the framers of the Cooper act. Judge Allen overruled their arguments, however, and upheld the contention of the company.

PRESENT-DAY JURISDICTION OF STATE BODIES OVER PUBLIC-SERVICE CORPORATIONS.

A very lucid discussion of the causes and conditions of modern commission regulation over public utilities was made before the Byllesby convention at Chicago, Jan. 4, by Mr. Isaac Milkewitch, of the law firm of Cummins, Stearns & Milkewitch, Chicago.

To appreciate properly the present-day jurisdiction of governmental bodies over public-service corporations, said the speaker, one must disabuse his mind of the idea that the government has within late years arbitrarily assumed the function of regulating certain business. Public callings are ancient institutions and the governmental function of regulation was known to antiquity.

Economic causes in ancient times gave birth to public callings and their regulation. Later, when these causes ceased to operate, all business became private and the governmental function of regulating practically ceased. But now, when similar economic conditions have again arisen, the number of public callings has increased and the governmental function of regulation is again revived and becomes active.

In the early rude communities abject poverty was everywhere. Fortunate was that community which contained even one follower of each of the necessary trades, such as miller, baker, blacksmith, shoemaker, tailor and surgeon. Frequently the size and poverty of the community were such that in order to eke out existence one person followed two or three trades. The surgeon, for example, was also the barber.

In a community where all the inhabitants barely made a living it was not likely that the shoemaker would refuse service to anyone who was able to pay therefor, nor was it likely that the prices charged would be unreasonable. In fact, the shoemaker furnished shoes to the entire community and in turn received food and clothes, and what took place was practically an exchange of products.

Thence arose a custom, which in time became law, that one holding himself out as engaged in any particular industry must furnish adequate service to all who applied for it, without discrimination and at reasonable prices. In the quaint legal language of the time the idea was enforced that if the only blacksmith in a community refused service a good horse would be ruined for want of a shoe. In the interest of all the people, practically all vocations were therefore considered public callings subject to regulation. The ideal of those times was a monopoly regulated by government so that all the people should receive fair treatment. Individual enterprise and initiative were as yet almost unborn. Under these conditions the people lived and prospered for a number of centuries. Thereunder commerce increased and craftsmen multiplied until each community had many tailors, blacksmiths, etc. Competition, pervading every industry, rendered unnecessary governmental regulation of any business excepting only transportation. But the law of inertia operates in society as elsewhere, and the change in economic conditions was not immediately followed by the cessation of governmental interference. The government continued to interfere, doing more mischief as the need for interference became less, until the people feared and hated all laws relating to trade.

The laws of a people reflect the spirit of that people at the time of their enactment. It was under this influence, while smarting from the injustice of unwarranted governmental regulations of commerce and at a time when the existence of strong competition rendered governmental regulations harmful, that the constitution of this government and those of most of the states of this Union were framed. It is therefore but natural that these constitutions should favor the policy of *laissez faire*, or non-interference.

Economic conditions determine ideals. By the middle of the nineteenth century competition had permeated every business, and the policy of *laissez faire* became the ideal. Almost every business, no matter how important, was considered a private calling. Such sway had this policy of *laissez faire* reached that in the sixties it was held that a gas company was a private business and had the right to serve only those whom it pleased and at such prices as it chose to charge.

The early development of business eliminated the necessity for regulation, but a further development again brought around need for governmental interference. This further development was slightly different in its nature from the early development. Up to about the first quarter of the nineteenth century business developed, with few exceptions, extensively but not intensively. This was due to the fact that prior to that time religion and war had engaged the attention of the men of the highest executive and organizing ability. Trade generally was held in contempt and the majority of those engaged in trade were men of ordinary capacities.

With the march of civilization religion and war declined and preferment in them became slow and uncertain, while with the increase of population and inventions the rewards of trade became princely and easy of acquisition. As a result, after the termination of the Napoleonic wars, men of keen intellect and vast abilities flocked to commerce, and then commenced an era of intensive development. While before business had extended by increases in the number of establishments, now the development occurred by increases in the volume of business transacted by each establishment and by the merging of many small undertakings into one large business.

The geniuses who now entered the commercial field saw but too clearly the economic waste of competition and set about to eliminate it; they saw the great rewards in concentration and formed gigantic corporations to secure them.

The pendulum had swung completely around. The economic conditions existing in the medieval period had returned in the middle of the nineteenth century. In the first competition was impossible because of widely scattered, small, impoverished communities; in the latter competition was virtually impossible in many industries because of the huge aggregations of capital. With the elimination of competition arose the need for governmental regulation, but, again following the law of inertia, governmental passivity continued in the middle of the nineteenth century when activity was required. The inevitable happened. Those in control, restrained neither by competition nor by governmental regulation, took advantage of every opportunity to oppress, and charged all that the traffic would bear. Service became wretched and prices high.

Appeals to the courts for relief from the burdens of monopoly became frequent, but relief was seldom granted. Lawyers and judges, hypnotized by the wonderful achievements under the policy of non-interference, oblivious to the economic changes that had taken place, forgot the great common-law principle that, in the absence of competition, the law ought to protect the many by compelling the few to furnish adequate service at reasonable prices, or, if they remembered the principle, thought that it had been abrogated by later constitutional and statutory enactments.

The first step in the direction of utility regulation was taken by the courts through a misconception. The doctrine was formulated that a calling monopolistic in its nature because of franchises obtained from the government ought

to be subject to regulation by the government. The conclusion was correct. The reasoning was wrong. The common-law principle was that all industries of a monopolistic nature are subject to regulation. Under the theory that when an industry has become a virtual monopoly and deals with a commodity involving the comfort and happiness of a large number of people it should be considered a public calling subject to regulation, the right to regulate is altogether independent of franchise rights.

The State of Illinois was the first to reaffirm the principle that the right to regulate an industry does not depend on any use by it of a franchise. This right to regulate is not only independent of franchises but it is superior to them.

The relief obtained through the doctrines thus enunciated was not sufficient to stem the tide of complaints against the evils of monopoly, and men ignorant of history and blind to hidden forces, remembering only that business had flourished under the free competition of the early part of the nineteenth century, clamored, not for the most efficient cure of the evils of monopoly, but for a return of the old competitive conditions, deeming this the universal remedy. Others who saw that certain lines of industry could not be carried on under competitive conditions advocated government ownership.

The movement for a return of the old competitive conditions has, however, in late years, attained an alarming strength. The Sherman act, the numerous state statutes against combinations in restraint of competition, the recent prosecutions under these statutes, and the encouragement everywhere given to competing public utilities, illustrate the strength of the movement to restore the old competitive conditions.

Instead of dissolving well-organized industrial giants, they should be regulated. In the opinion of the speaker, the men of stupendous organizing ability should be encouraged to build higher and higher, to make one corporation grow where two grew before, but to have that one corporation do the work of the two more effectively and more economically.

There are those who have added fuel to the rage against corporations by resisting regulation, by constantly crying that regulation is a denial of their sacred constitutional right to freedom of contract and the pursuit of happiness.

It is true that the right of each individual to life, liberty and the pursuit of happiness is sacred, but still more sacred is the same right of all the people to their lives, liberties and happiness, and it is to preserve this latter and more sacred right of all the people that governmental regulation becomes necessary whenever competition fails to procure adequate service at reasonable prices without discrimination.

PUBLIC SERVICE COMMISSION NEWS.

NEW JERSEY COMMISSION.

A number of decisions of the New Jersey Board of Public Utility Commissioners have been recently issued in printed form. One of these, under date of Jan. 26, gives decisions in the matter of two telephone companies which petitioned for authority to issue securities. In both cases the petitions were dismissed. In the opinion it was stated that before approval of interest-bearing securities will be given there must be reasonably good warrant that the stipulated interest payments can be regularly met, and that it will not suffice that the eventual payment of the principal, or even the eventual payment of principal and overdue interest, is secured. The board in its opinion laid down the principle that unified and exclusive control and operation of telephones within a given area was preferable to a competing telephone system, with its inevitable disadvantages of divided service and duplicated costs; nevertheless, as between rival interests striving to operate the same telephone properties, the board must maintain an attitude of complete neutrality and impartiality.

The commission has issued two memoranda relating, one to the minimum monthly charge for electric-lighting service and the other to the minimum charge for electric-motor service. The memoranda contain a discussion of the principles of rates and conclude with the decision that the exaction of the minimum charge is a reasonable rule; that a monthly charge is really more equitable than an annual minimum charge; that a charge of $1 per month per installation is just and reasonable, but that a rate of $1 per meter is excessive where more than one meter is installed, though a minimum charge of 50 cents per month per meter is not unreasonable for each additional meter; that where a customer requests the service to be discontinued for a period of one month or more the minimum charge should be waived during that period; that where a customer requires service for a limited period only a reasonable charge may be made for the work of connecting and disconnecting the service at the beginning and end of the period; that rules and regulations concerning service and all information in regard to rates and rate schedules should be available to the present or prospective customer, and that the minimum charge is part of a rate schedule.

In the matter of motor service the board decided that the exaction by a company of a charge at the rate of 50 cents per hp per month is not excessive or unreasonable, and that a minimum charge in connection with electric-motor service of $1 per month is likewise not excessive or unreasonable.

Two earlier decisions related to the reasonableness of rates charged by gas-light companies for gas. In both cases an analysis in detail is given of costs. In the case of the Lambertville Gas Light Company it is shown that, while the capital stock is $30,000, the property is now worth approximately $75,000. Assuming the property is to be kept up to a value of 70 per cent of the cost of reproduction, the proper capital stock which ought to be outstanding against the property, and upon which the property should be entitled to earn for dividend purposes, would be $54,500. The balance, or $20,500, properly belongs to the depreciation fund, and upon that also the company would be entitled to earn, but such earnings, if received, should not be paid out in dividends but added to the depreciation fund. The conclusion is this case is that, as the company has been paying only 4 per cent dividends on its capital stock, which is very much less than the value of the property, no change should be ordered in the price of gas based on the present operating conditions.

In the case of the Salem Gas Light Company, an analysis of the accounts show that prior to 1906 the stockholders had received, either in cash or in new stock, an amount which averaged a fair return on the original investment, and hence in the last five years were entitled to no more than a fair return on the existing investment, as deficiencies in earnings in prior years had been fully made up. During the last five years the average profit per 1,000 cu. ft. of gas sold was 45 cents, from which the company was enabled to pay 10 per cent dividends during the last two years and put aside a surplus amounting to 2.65 per cent. The cost to reproduce the property is approximately $98,000, and an allowance of $29,400 should be carried on the books as a depreciation reserve. Extensions, however, from the income have been made to the value of $24,000. The final conclusion is that the company is reasonably entitled to a return upon the cost of plant and working capital, amounting to a total of $102,614, but before dividends are declared an amount equal to 5 per cent upon the depreciation fund invested in extension of plant must also be set aside from the net earnings to the credit of the reserve. An order was issued that the price of gas should be reduced from $1.60 to $1.55, the present system of discounts to remain.

OHIO COMMISSION.

The Cincinnati & Suburban Bell Telephone Company has requested the Public Service Commission to allow until March 7 to file a written answer to the application made by the Hamilton Home Telephone Company some time ago for right of long-distance service into Cincinnati over its lines. The commission has granted the request and set March 18 as the date of the formal hearing. The commission has received a petition from the Hamilton Board of Trade and another from several thousand Hamilton citizens asking that the Independent lines be allowed to connect with the Bell system at Cincinnati. The commission will take these petitions into consideration.

The particular clause applying to the case is found in Section 66 of the law and provides that the commission may order physical connection between the lines of two companies in order to secure communication with any point "which cannot be reached or communicated with by the lines of either company." It is argued that the Legislature intended that if either of two companies were connected with a certain point and the other were not, the company which had no such connection should have it over the lines of the other company. It is reported that attorneys for the Bell company will construe the law as meaning that the commission has no authority over the situation at Hamilton, and that where two or more companies are operating in a town and one of them has connection with a certain city, the commission has no authority to order physical connection with the other company. This can be done, under the law, only when neither of them reaches the desired point, it is asserted.

If the commission rules against the Bell company, it is said that an injunction will be sought and the case will be carried to the Supreme Court for a final interpretation of the law. The attorneys allege that the Bell company is not violating any trust feature of the law nor is it discriminating against anyone, as the citizens of Hamilton are at liberty to subscribe for its service and use its connections with the Cincinnati system.

NEW YORK COMMISSION.

On Feb. 20 the Public Service Commission granted authority to the Adirondack Electric Power Corporation, which has taken over various electric companies generating energy on the upper Hudson River, to issue $9,500,000 in capital stock, $2,500,000 in preferred stock and $5,000,000 in fifty-year 5 per cent gold bonds. In rendering its decision the commission called attention to the fact that it authorized the capitalization proposed by the plan of reorganization, without reference to the value of the properties to be taken over by the new corporation, solely because the law compels it to make such decision. The law referred to is the ruling of the Court of Appeals in the Third Avenue (New York) Railway case, according to which the supervision of the commission over reorganization is limited to determining that the securities of the reorganized corporation are not in excess of the valid outstanding securities of its predecessor.

The new corporation is a reorganization of the Hudson River Water Power Company, Hudson River Power Transmission Company, Saratoga Gas, Electric Light & Power Company, Hudson River Electric Company, Hudson River Electric Power Company, Madison County Gas & Electric Company and Empire State Power Company.

Hearings were continued on Feb. 19 before Commissioner Maltbie, of the First District, on the complaint of certain organizations of stationary engineers in New York City that discriminatory rates are given by the New York Edison Company to large users of energy. Progress is being made very slowly by the complainants in presenting their case. Nothing of moment transpired at the hearing on Feb. 19. The general inspector and general agent of the company was asked a long series of questions upon the methods of the company in soliciting business, none of which, it was contended by the counsel for the Edison company, was pertinent to the inquiry. The next hearing is scheduled for Feb. 29.

MARYLAND COMMISSION.

Messrs. W. Cabell Bruce, general counsel, Louis M. Duvall, secretary, and Charles E. Phelps, consulting engineer to the commission, appeared before the House corporations committee of the State Legislature last week and made statements as to the work of the commission. Mr. Duvall presented a statement referring particularly to the commission's investigations of the United Railways, Consolidated Electric Company and Chesapeake & Potomac Telephone Company. Mr. Duvall said that during the first year, from May, 1910, to May, 1911, the cost of maintenance of the commission had been $47,000, and $28,000 of the $75,000 appropriated had been returned to the State treasury.. He estimated that for the year ending May, 1912, the expenses of the commission will aggregate between $58,000 and $60,000. Mr. Key, of Baltimore, said that he had represented a prospective competing Baltimore concern and was informed from a corporation source that there was no chance to get in with the new company, and he had found it so. Mr. Key wanted to know why the commission had hired expert engineers outside of Baltimore when they could be had at home, and was informed by Mr. Bruce that the commission desired to secure the services of the best engineers to check up the engineers of the telephone company, and it believed that it had done so. A general discussion as to telephone rates ensued owing to the change in the schedule to take effect on May 1; also about electric-light rates, meters, reading, etc. The corporations committee took no action on the matter.

Current News and Notes.

STATE MONOPOLY OF ELECTRIC SERVICE IN URUGUAY.—The Congress of Uruguay has under consideration a message from the President which proposes to confer upon the state the exclusive right to generate and distribute electric energy in the republic.

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COLLEGE ELECTRICAL SHOW.—The electrical section of the senior class at the Georgia School of Technology in Atlanta gave the second annual electrical show in the electrical building on Feb. 9. Each one of the twenty-eight men in the section had an exhibit to prepare and explain. Electrical cooking and welding, X-ray apparatus, cooking on ice and other experiments with induction apparatus proved attractive to everyone. The attendance at each of these shows taxed the capacity of the building. The proceeds of the first show were used for the erection of two handsome electric-light standards at the entrance to the electrical building, and the profits this year will be used for some similar purpose.

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MEETING OF NEW YORK COMPANIES' SECTION, N. E. L. A.—The speaker at the regular monthly meeting of the New York Companies' Section of the National Electric Light Association in New York City Feb. 19 was President J. Gilchrist, of the N. E. L. A., who spoke on the National Electric Light Association, particularly with reference to its scope and organization, explaining the significance of the various committees, the different classes of members, their relations toward each other and toward the organization as a whole. It was purposed to have a discussion on the general topic of the relation of the employee to the employer and to the public following Mr. Gilchrist's address, but time did not permit.

Convention of American Electric Railway Association.—The 1912 convention of the American Electric Railway Association and its affiliated associations will be held at Chicago, Oct. 7-11. The exhibits will be located in the Dexter Pavilion, corner Forty-third and Halsted Streets, and the meeting halls will be close to the pavilion.

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Meeting of Electric Vehicle Association of America.—At the next regular meeting of the Electric Vehicle Association of America, which will be held in the Engineering Societies Building, New York City, Feb. 27, Mr. Alexander Churchward will present number two of his series of papers on the subject "Standardization of the Electric Vehicle," the present paper dealing with speeds. The stereopticon will be used to illustrate the lecture.

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Telegraphers' Union Wants Government Ownership.—According to the newspapers, Chicago Local No. 1 of the Commercial Telegraphers' Union of America has adopted resolutions demanding government ownership of telegraph and telephone lines in the United States. The resolutions assert that "private ownership and exploitation of the telegraph and telephone in the United States have resulted in inadequate facilities, high rates, slow, inaccurate and discriminatory service, and most merciless sweating of employees."

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Armour Branch, A. I. E. E.—"The Engineering Application of Storage Batteries" was the subject discussed by Mr. P. G. Downton, of the Electric Storage Battery Company, before an evening meeting of the Armour Institute of Technology Branch, American Institute of Electrical Engineers, Chicago, Feb. 14. A general review of the possibilities in the use of batteries in railway and central-station work was presented by the speaker, who described the use of line batteries, regulating batteries and substation batteries.

* * *

Rejuvenation of Sons of Jove in Pittsburgh.—A rejuvenation of the Sons of Jove was held at the Fort Pitt Hotel, Pittsburgh, Pa., Feb. 23, and a large number of members were initiated. Plans were also discussed for the national convention of the "Sons of Jove," at which over 6000 members are expected to be in attendance. The convention was secured for Pittsburgh through the efforts of the Pittsburgh Industrial Development Commission and Mr. Henry Harris, who made a successful bid at the last convention held in Denver last October. The convention this year will be held in Pittsburgh the week of Oct. 15.

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Central Stations Busy Thawing Out Frozen Water Pipes.—During the severe cold weather of the last few weeks the central-station companies throughout the Wyoming Valley, Pennsylvania, notably at Wilkes-Barre, Plymouth, Kingston and other points, have been very busy thawing out frozen water pipes in their respective localities. It has been demonstrated there, as well as elsewhere, that after slight thaws the number of pipes frozen is considerably increased, due to the melting of the snow and its refreezing thereafter, causing the frost to get deeper into the ground. At Rochester, N. Y., the company has six gangs at work thawing out pipes under the direction of the City Water Department.

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Meeting of the Philadelphia Section of the I. E. S.—The regular monthly meeting of the Philadelphia Section of the Illuminating Engineering Society was held on Feb. 16. Prof. A. J. Rowland gave the second of his series of five talks to be delivered before the section, his topic on Friday being "Candle-Power." The paper of the evening, "The Physics of Light," was presented by Dr. G. A. Hoadley, of Swathmore College. Dr. Hoadley supplemented his paper by lantern illustrations and practical demonstrations. A committee of five members was appointed by the chairman to consider plans for suggestions to and conference with the committee on nomenclature and standards of the Illuminating Engineering Society, with reference to standard symbols for electric wiring and gas piping. The usual dinner, at which sixty-three were present, preceded the meeting.

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Colorado Electric Club.—At a meeting of the Colorado Electric Club on Feb. 8 the entertainment and organizations committees were instructed to enlist the co-operation of the Denver Chamber of Commerce in securing the routing of the N. E. L. A. special convention train by way of Denver and entertaining the 1500 members and guests during a brief stop-over in Denver. On Feb. 1, at a meeting presided over by Chairman W. J. Canada, Mr. J. W. Kelley, assistant general attorney of the Denver & Rio Grande Railroad, stated that Denver is the largest manufacturing city in the West, except San Francisco, having a factory payroll of $1,000,000 per month. One person of each thirteen population is employed in a factory. This condition he attributed to the exceptional facilities of Denver, in the midst of coal fields and water-powers, as a producing and distributing point.

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New York Jovian Luncheon.—The regular semi-monthly luncheon of the Sons of Jove of New York was held on Feb. 21 at Kalil's Restaurant. The speaker was Mr. H. L. Doherty, whose subject was "The Wage Earner as an Investment." There is probably no other man in the electrical industry who understands and is able to discuss this important subject better than Mr. Doherty, and the information which he imparted, with the help of charts specially prepared for the occasion, proved most interesting. Announcement was made at this luncheon that at a meeting of the Jovian Congress recently held Mr. Robert L. Jaynes, Tenth Jupiter, had conferred honorary membership upon Mr. T. Commerford Martin, secretary of the National Electric Light Association. The election of Mr. Martin had the unanimous approval of the Past-Jupiters' Association and was enthusiastically received by members present.

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Electric Show at Connellsville, Pa.—The West Penn Electric Company is conducting an electric show in a store next to the post office at Connellsville, Pa., from Feb. 22 to March 2. The company has erected eighteen booths, all of which are painted white and most of which are occupied by local contractors and large Pittsburgh jobbers. The Westinghouse Electric & Manufacturing Company has a heating and lighting display, and exhibits are also made by the Holophane Company, the Macbeth-Evans Glass Company and the Federal Sign System. The West Penn Electric Company also has a number of booths fitted up for demonstration purposes. The company has fathered the expense of the entire undertaking and has stretched across the street outside the building a temporary electric sign 22 ft. by 6 ft., reading "Electric Show." For a distance of two blocks streamers of 4-cp lamps are run in zigzag fashion from pole to pole on the main street. The company is advertising in the local papers and on the trolley cars and in addition is distributing blotters in all of the suburban towns and extending special invitations to the ladies. Although Connellsville has a population of approximately only 14,000, the company expects to have at least 5000 visitors at the show. It is offering to non-consumers whose houses are not wired a free electric iron, provided the houses are wired and connected to the company's circuits by the first of May. If customers prefer a flat rate, the company will present four 20-cp tungsten lamps free of charge.

REDUCED RATES IN VIRGINIA, MINN.—The Virginia Electric Power & Water Company, of Virginia, Minn., has made a reduction to small consumers amounting to about 12 per cent. This is the third reduction made by the company within three years. In the city of Virginia there is a graduated rate schedule, the maximum rate for the first 20 kw-hr. per month being 10.8 cents.

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PROPOSED PUBLIC-UTILITY REGULATION IN INDIANA.—A law providing for the regulation of public utilities is being considered in Indiana. Governor Marshall of that State says that the study of the public-utilities laws in other States has convinced him that instead of organizing a new commission Indiana should increase the powers of the State Railroad Commission to include other public utilities.

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LOCAL COMPANY IN JACKSONVILLE, ILL.—The Jacksonville Gas & Electric Company, of Jacksonville, Ill., was incorporated on Feb. 13. The incorporators are Messrs. H. E. Chubbuck, E. W. Fowler and F. C. Buffe. The Jacksonville Railway & Light Company has been operated as a part of the Illinois Traction System, and it is probable that the new company has been organized as an Illinois corporation to take over the local property.

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ELECTRIC CLUB OF KANSAS CITY.—The first meeting of the seventy-five members of the new Electric Club of Kansas City, Mo., was held on Friday evening, Feb. 9, at the Kansas City University Club, Eleventh and Baltimore Streets. Following the dinner Mr. A. A. Gray, president of the Electric Club of Chicago; Mr. F. Laurant Godinez, of New York, and other speakers were introduced by Mr. F. M. Bernardin, president of the Electric Club of Kansas City.

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"NICKEL-FIRST" TELEPHONE SERVICE.—In the controversy over "nickel-first" versus "nickel-last" telephone service which has been raging in Chicago the Chicago Telephone Company prints a five-column advertisement in the Chicago newspapers stating the advantages of the former system. It is said that the superior efficiency of "nickel-first" service is recognized everywhere. The interesting statement is made that the company's engineers and consulting experts have invented a device which will enable the subscriber to get in communication with the operator, in case of emergency, without the use of a nickel or slug. The subscriber pushes a button which actuates a flashing signal in front of the operator. The latter recognizes this signal as a call for police, a fire call or as some other emergency.

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COST OF ELECTRIC STREET LIGHTING IN CHICAGO.—Mr. Hans Schaedlich, electrical engineer for the Department of Electricity of the city of Chicago, addressed the Chicago Real Estate Board Feb. 8 on the subject of the city's street lighting. In 1887, he said, 400 miles of Chicago streets were illuminated at a cost of 85.6 cents per cp-year. In 1911, 1200 miles were lighted at 16.25 cents per cp-year. With the addition of the 10,000 lamps now being installed, a large proportion being flaming arcs, 1700 miles of streets will be lighted, the operation of the new illuminants costing but 1.35 cents per cp-year. The initial replacement includes 5500 direct-current inclosed-arc lamps, the alternating-current circuits being provided with the new lamps later. The possible 20,000 additional lamps now under discussion for Chicago will bring the total up to 2850 miles of illuminated streets. Berlin, Germany, has been heralded as one of the best lighted of cities, but in comparison with Chicago investigation shows that only 17 miles of its streets are lighted on the scale that has attracted so much attention, while but 200 miles are lighted by gas. In a city where the density of population is as high as in Berlin the small street mileage makes high illumination possible without making the per capita cost excessive. Even should all of the suggested 30,000 new lamps be installed in Chicago, 200 miles of streets will remain to be lighted by some other means, perhaps by high-pressure gas lamps ranging from 1500 cp to 4000 cp each.

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TELEPHONE RATE REGULATION.—Mr. Frank F. Fowle was the speaker at the meeting of the Electric Club of Chicago on Feb. 15. His subject was "Telephone Rate Regulation" and he sketched the history of rate regulation and explained the cost-of-service theory and the value-of-service theory. Rapidly but thoroughly Mr. Fowle analyzed the method of determining the fixed and variable expenses in telephone service and pointed out that it might be possible in arranging equitable telephone rates to establish a minimum service charge, to which a measured-rate charge of possibly 1 cent for each outgoing call might be added. Telephone rates, the speaker said, have not been investigated as much as electric-service rates. In relation to the local situation in Chicago, Mr. Fowle mentioned the number of rate investigations that have been made of various utilities and said that no doubt there had been a waste of public money in handling the rate situation. City officials need the advice of competent experts, but once they have retained an expert they should repose confidence in his honesty and good judgment. In closing the speaker advocated the state regulation of public utilities by commissions. Mr. M. W. Zabel and others took part in a brief discussion.

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ELECTROLYSIS.—Prof. Albert F. Ganz, of the Stevens Institute of Technology, Hoboken, N. J., addressed the Luncheon Club branch of the New England Section, N. E. L. A., at the regular weekly gathering at Boston on Feb. 9, his subject being "Electrolysis." Mr. I. E. Moultrop, of the Boston Edison Company, presided and about 300 electrical men were in attendance. Professor Ganz said that electrolytic corrosion where current leaves pipes will destroy 20 lb. of iron or 60 lb. of lead in one year for every ampere of flow. Bonding pipes to negative return circuits does not furnish adequate protection to water and gas piping systems, because these do not form continuous metallic networks from the conducting standpoint. Most electrolytic troubles are due to defective rail bonding, to ground connections from the negative terminal of the generator or to lack of adequate return feeders. Stray currents can be greatly reduced by removing all ground connections from the negative generator terminals and installing insulated return feeders from radially disposed points in the track system located at some distance from the power house, thus draining the rails of current at these points. Regulations requiring such practice are in effective use in Europe. Current may enter a building by a gas-service pipe, flow from the gas to the water piping through house connections and then flow out of the building by the water-service pipe. Such connections between the service pipes in buildings are frequently made through metallic ceilings or where the pipes come in contact with each other, and where currents of considerable magnitude flow from one pipe to another in this way they form a serious fire hazard, on account of the arc which is formed when vibration occurs and separates the contact. The important features of protection against electrolysis are high rail conductivity, minimum rail drop, high resistance from rails to ground and to pipes and high resistance along the lines of pipes. Professor Ganz unqualifiedly condemned the practice of promiscuously bonding pipes to rails to cure electrolysis. The speaker scheduled for Feb. 16 was Mr. Harvey S. Tonks, general manager of the Ornamental Lighting Pole Company, New York, his subject being "The Commercial Possibilities of Ornamental Street Lighting in New England."

Electric Smelting in Sweden.—A 12,000-hp electric smelting plant for pig-iron is now being constructed at Domnarfvet, Sweden. This plant is the outcome of the successful experiments at Trollhättan, described in the *Electrical World*, Dec. 9, 1911. It is stated that machinery and apparatus of Swedish make will be used throughout.

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Public-Utilities Regulation in the District of Columbia.—An additional bill providing for the creation of a public-utilities commission in the District of Columbia has been introduced in the House of Representatives by Congressman Frank E. Doremus, of Detroit. This bill is similar to the one introduced in December by Mr. Oldfield, of Arkansas, of which mention has been made in this journal.

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Committee Work of Electric Club of Chicago.—At a meeting of the board of managers of the Electric Club of Chicago on Feb. 17, President Gray appointed the chairmen of the standing committees of the club as follows: Speakers, Mr. Perry R. Boole; entertainment, Mr. H. G. Hafner; membership, Mr. James H. Delany; house, Mr. James R. Cravath; finance, Mr. Norman F. Obright; civics, Mr. D. W. Roper.

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Proposed Local Regulation in Pittsburgh.—Mayor Magee of Pittsburgh advocates the establishment of a local bureau of public utilities. Public-utility commissions are usually state organizations, but there are a number of cities where the commissions have only local jurisdiction, as in St. Louis, Kansas City and Los Angeles. In New York State there are two commissions, one having New York City and the other the remainder of the State.

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New Insulating Material.—An insulating material made from ordinary seaweed has been produced by an English chemist, Mr. John S. Campbell. Recent tests carried out at the Westminster Electrical Testing Laboratories are said to have proved it to possess all the ordinary merits of an insulator besides having an unusually high resistance. Immersed in water the test showed a resistance of 30,000,000 megohm-centimeters. Samples 1 mm thick withstood from 9000 volts to 16,000 volts alternating current before being punctured.

* * *

An Electrical Discovery in 1840.—A correspondent sends us the following item from *The New World*, a periodical published in New York seventy years ago, the date of the issue from which the clipping was taken being Aug. 29, 1840: "Extraordinary Discovery.—A late Paris paper says that a very humble individual has found means of fixing the electric spark for public lighting, and that he can produce a permanent flame of 30-in. diameter, which would light a great part of Paris. The only danger attending it is said to be in the apparatus of supply, which must be isolated, and it is so strongly charged that a person touching it would be struck dead immediately."

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Commercial Section, N. E. L. A.—An all-day meeting of the executive committee of the National Electric Light Association was held in the Hotel Sherman, Chicago, on Feb. 9. Progress reports were received from the various committees, and an outline program for the commercial sessions at the Seattle convention was discussed. It is believed that all the committee reports will be completed by April 1, and if this consummation, which is devoutly to be wished, is attained, it will constitute a record in N. E. L. A. performance. Mr. H. J. Gille, of Minneapolis, is chairman of the executive committee and Mr. Philip S. Dodd, 29 West Thirty-ninth Street, New York, is secretary.

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Damage by Sleet Storm.—On Jan. 6 and 7 there occurred in Portland, Ore., and its neighborhood a very severe sleet storm which caused much damage to telephone and telegraph lines and considerable damage to electric lighting circuits. Mr. W. G. Chase, assistant general manager of the Mount Hood Railway & Power Company, reports measurements made at Bull Run, Ore., which showed No. 14-BB galvanized wires to have accumulated an overall diameter of 1 in. at a weight per foot of 0.325 lb. Spans of 125 ft. were not injured, but two spans each of 275 ft. were entirely demolished. All electric lighting and telephone wires of sizes up to No. 8 in that neighborhood were broken down, while larger sizes were badly sagged, the average span being 150 ft.

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Contract Order Routine.—A meeting of the contract order routine committee of the National Electric Light Association was held in Chicago on Feb. 9 and 10. This committee is studying the contract order routine of the larger electric-service companies with the idea of combining the best features of all in a plan to be recommended to the N. E. L. A. as a standard. The effort is to save expense, possibly, in handling customers' orders, but more especially to save time in connecting up the customer after the order is placed. The report will go into the subject in some detail. Mr. T. I. Jones, general sales agent of the Edison Electric Illuminating Company of Brooklyn, is chairman of the committee, and the next meeting will be held in Brooklyn on March 1 and 2.

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Wireless Telegraphy at Carnegie Schools.—Plans are being prepared for the installation of the most powerful wireless-telegraph station in the country, excepting those in seacoast cities, in connection with the completion of the new building for the departments of mechanical and electrical engineering at the Carnegie Technical Schools. The equipment will be of sufficient power to send messages to the Atlantic seaboard. Upon the installation of the station a course in wireless telegraphy will be added to the curriculum in the department of applied science. The new course will be in addition to the classes in telegraphy and telephony which now constitute a part of the prescribed courses at the schools. A wireless club organized by the students has now a membership of fifty. A temporary wireless station will be ready before the end of the present school year, and it is proposed to send the first message to the United States Naval Academy at Annapolis, Md.

* * *

Iowa Conventions and Des Moines Electric Show.—The Iowa Electrical Association and the Iowa Street Railway Association will hold their annual conventions in conjunction this year, as usual. The meetings will be held in Des Moines on April 24, 25 and 26, the central-station men taking the first day for themselves, the second day providing joint meetings for both associations and the last day being more particularly for the electric-railway men. During the convention the Des Moines Electric Company will give its first electric show. Diagrams showing the location of exhibit spaces have been issued, and exhibitors will be charged only for the erection of booths and for decoration, the whole amount being very moderate. The show is not intended to be a money-making affair, but will be given by the local electric-service company for the benefit of the visitors to the conventions as well as for the general public. It is hoped that about 300 members and visitors will attend the conventions. Mr. C. A. Willoughby, Des Moines Electric Company, Des Moines, Ia., can give information about the arrangement of details.

HYDROELECTRIC STATION FOR NORTHERN ILLINOIS COMPANIES.

An Extremely Low-Head Development on the Illinois River Which Feeds Energy to Transmission Lines for a 125-Mile Interurban Railway and Serves Six Small Electric-Lighting Systems.

THE McKinley properties in northern Illinois, which include the Northern Illinois Light & Traction Company, the Chicago, Ottawa & Peoria Railway, the Consolidated Water & Light Company of Marseilles and the Citizens' Lighting Company of La Salle, are now receiving energy from a new hydroelectric station at Marseilles, Ill., located 35 miles southwest of Joliet, on the Illinois River. The station was first put in service in October, 1911. At that time, however, the equipment had not all been installed and the station was used only to assist the steam station at La Salle, which was feeding energy to the Chicago, Ottawa & Peoria Railway's 125-mile interurban line, and the steam plant of the Northern Illinois Light & Traction Company at Ottawa. The new station will be operated in parallel with two other generating stations now in service on these properties, one a steam station at La Salle and the other a combination hydroelectric and steam station at Ottawa. The latter will be operated as a swing station which will assume the peak loads, and the former will only be cut in on the line in case of a complete shutdown.

Fig. 1—Interior View of Generating Room.

It is of historical interest to note that the Marseilles Land & Water Company, a corporation now headed by Mr. W. D. Boyce, of Chicago, first constructed a dam across the Illinois River at Marseilles and sold water rights more than forty years ago. This dam has since been replaced by a concrete ogee dam and now diverts water for the operation of several large manufacturing plants located in Marseilles. Under normal conditions there is an excess of water, and the right to use this surplus, along with a number of long-term water-right leases, was acquired about two years ago by the McKinley interests. At this time these interests also purchased a small lighting company known as the Consolidated Water & Light Company of Marseilles and a short railway known as the Manufacturers' Terminal Railway. The purchase of the latter properties furnished sufficient land one-half mile below the dam at the lower end of the water-supply channel on which to build the new power plant. The relative locations of the plant, the north channel and the dam are shown on the accompanying map. The water for the manufacturing industries is supplied through three separate channels; these have been cross-connected by overflows placed at such elevations as not to reduce the actual water requirements of the existing industries and yet to supply the new hydroelectric station with the surplus water. The headgates to the north channel which furnish the water supply for the new plant are located approximately 2400 ft. away, and the water flows through a channel averaging 80 ft. in width and 17.5 ft. deep.

STATION CONSTRUCTION FEATURES.

The new station building, which conforms in design to the Illinois Traction System standard substations, is 229 ft. long by 40 ft. wide and has a transformer annex 38 ft. 8 in. by 77 ft. 2 in. in plan. The clear headroom is 26 ft. in both sections of the station. A water-supply pumping station and heating-plant annex, 18 ft. by 53 ft. in plan, is located at the east end of the main building.

The station is provided with ample track facilities for handling equipment. A spur from the Terminal Railway extends into the west wing of the building and under a Case electric crane which has runways extending the full length of the main building. The crane is of 20-ton rating and has an auxiliary hoist which is used to operate the emergency steel gates employed to shut off the water supply to the individual turbine flumes. It was installed as soon as the steel work was completed, and the engineers state that the crane probably paid for itself by reduced cost of handling all the station equipment during the construction period.

WATER TURBINE AND FLUME CONSTRUCTION.

The engineers determined, after they had made careful tests of the surplus water supply during an extremely low-water period in June, 1910, that the minimum power to be obtained would be 4500 hp with an 11-ft. head. The turbine installation to develop this minimum horse-power consists

of six new 74-in. Samson Special water turbines operating at 75 r.p.m., six 62-in. Samson turbines which were formerly in the plant of the Consolidated Water & Light Company, and two 40-in. Samson Special turbines. As mentioned previously, each turbine is equipped with an individual flume controlled during an emergency by large built-

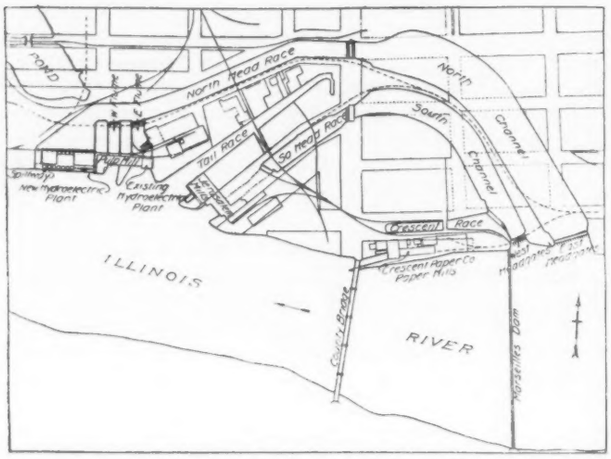


Fig. 2—Map Showing Location of Plants.

up steel gates which are kept on the station-floor level and are lowered through openings in the floor by the electric crane. These floor openings are covered with reinforced-concrete slabs built in structural steel frames and are provided with two rings countersunk to the level of the floor. In case it is necessary to close the flumes for an extended period, wooden stop-logs may be inserted in the slides provided on the turbine side of the gates and the steel gates may be removed. Slots also are provided on the outlet side of the discharge flumes so that they may be cut off from high water in the river, thus making the lower parts of the water turbine accessible at all times for repair.

TRASH RACKS AND SHEER BOOM.

The trash-rack bars and separators were designed especially for this station. They are built in sections 24.5 in. by 16 ft. No part of the steel work extends above the water level, and thus the tendency to form anchor ice during periods of low temperature is reduced. The racks and their supporting structure are so designed that they will withstand the entire head of water in case an ice gorge should

piles carried up from the bottom of the forebay, is so located that it deflects practically all the floating trash to the spillway at the extreme west end of the station building.

HYDROELECTRIC EQUIPMENT.

Each 74-in. turbine is directly connected to a 320-kva

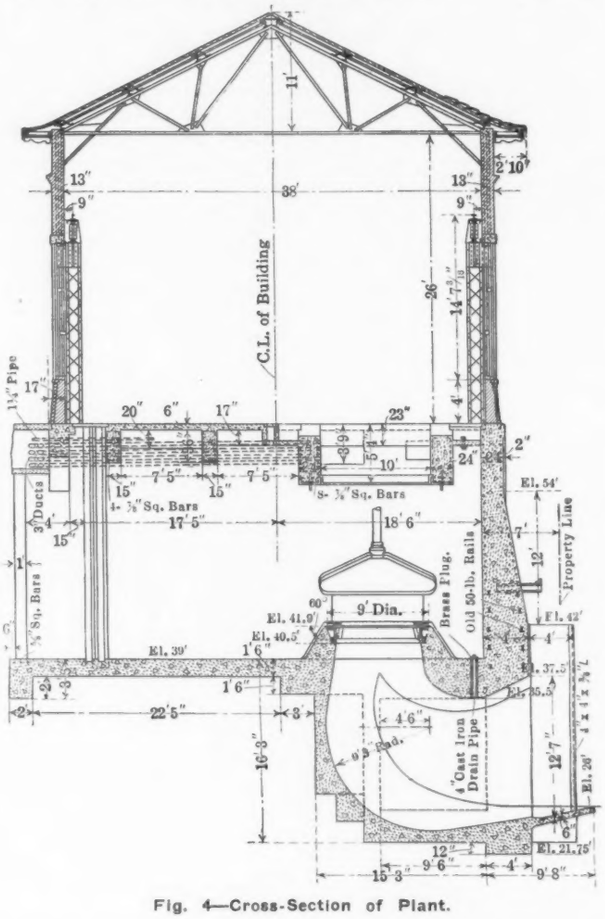


Fig. 4—Cross-Section of Plant.

Westinghouse generator located on the building-floor level and supported by heavily reinforced concrete beams between the flume walls. Four of the generators supply 25-cycle, 2300-volt energy for transmission at 33,000 volts

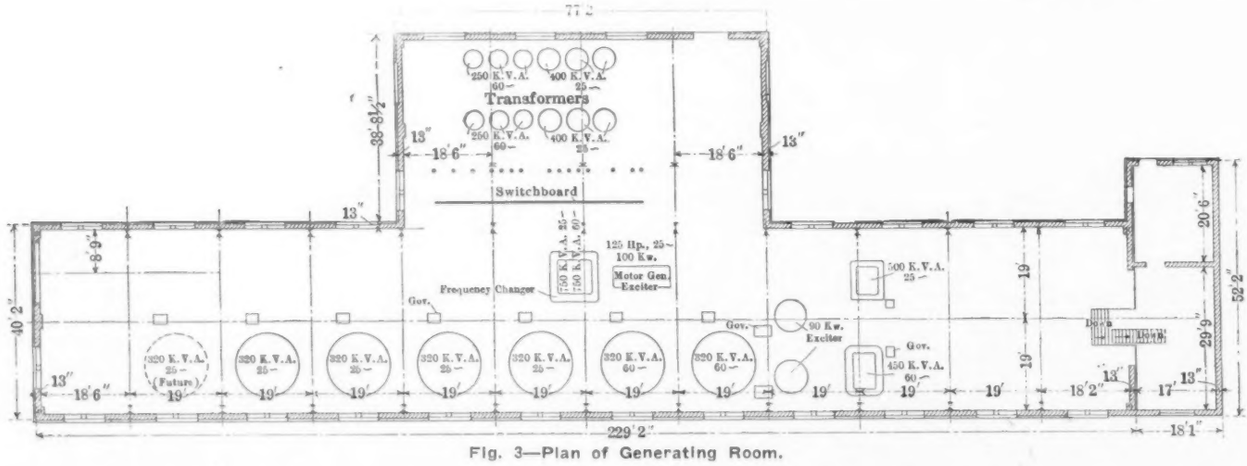


Fig. 3—Plan of Generating Room.

form. The steel work which supports the racks also serves as a portion of the bridge which carries the Manufacturers' Terminal Railway track over the forebay. The sheer boom, which presents a novel feature in its installation, in that it is anchored to ten uniformly spaced reinforced-concrete

to the Chicago, Ottawa & Peoria Railway, and two furnish 60-cycle, 2300-volt energy to a 33,000-volt transmission line serving six small lighting companies. An additional flume has been provided for a seventh turbine and generator which will be installed later. Directly connected water

turbines were recommended for this new installation, even at a higher first cost than for gear-connected units. The higher efficiency of the directly connected units, and the fact that the equipment could be continuously loaded to approximately 100 per cent of its rating, warranted their installation.

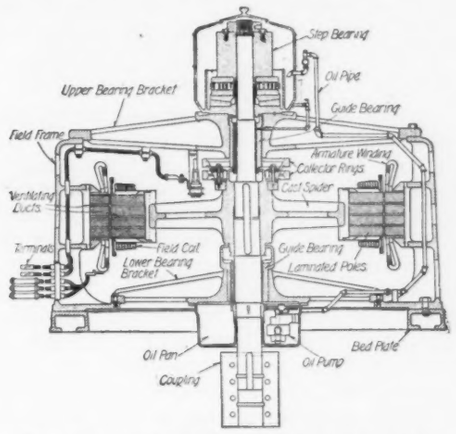


Fig. 5—Cross-Section of Vertical Generator.

The six old 62-in. Samson turbines are divided into groups of three machines, and each group is gear-connected to a horizontal shaft generator. One generator is a new 500-kva, 25-cycle, 2300-volt Westinghouse unit operated at 225 r.p.m.; the other generator is a 450-kw, 60-cycle, 2300-volt General Electric unit operated at 200 r.p.m., which was taken from the old plant of the Consolidated company.

Each water turbine is individually controlled by a Lombard one-second-movement hydraulic governor. Some interesting features in the governor installation are that each generator is provided not only with a governor but with separate oil tanks and pumps which maintain the oil supply at 200 lb. pressure, and that the governors are controlled through push-button switches located on the main switchboard, thus enabling the operator to adjust the speed of the generators when synchronizing.

FREQUENCY CHANGER AND EXCITATION.

Owing to the decrease in the demand for 60-cycle energy during the day and the increased demand for 25-cycle energy for interurban service, a 750-kva, 60-to-25-cycle frequency changer set, operating at 300 r.p.m., was included in the station equipment. This is of sufficient size to allow the entire generating equipment of the plant to be utilized for either the 60-cycle or the 25-cycle load.

A point of special interest in the design and installation of the frequency changer is the amount of floor space required. It occupies 105 sq. ft., a minimum for this size and type of generator, and the reduction in the required floor area was obtained by making the set two-bearing, with the generator and motor located a minimum distance apart.

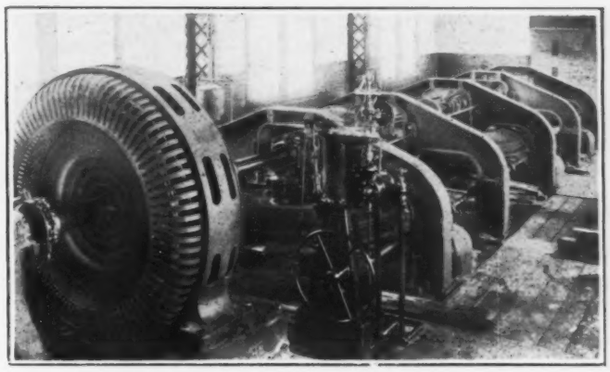


Fig. 7—Generator Driven from Three Turbines.

The end-bells are inclosed on the adjacent sides of the two machines, thus assuring effective ventilation. The set is self-starting, operating the motor as an induction machine, and hence synchronizing devices are unnecessary.

Energy for excitation is obtained from two 90-kw Westinghouse generators, directly connected to the two 40-in. water turbines operating at 100 r.p.m., and one Westinghouse motor-generator exciter of 100-kw rating. To prevent any serious interruptions from ice gorges in the river below the station, necessary precautions were taken to provide the 100-kw, 60-cycle motor-driven exciter. This may be operated in case of a complete shutdown by energy obtained from an outside source to furnish excitation to the frequency changer for interurban service.

SPECIAL FEATURES IN GENERATOR CONSTRUCTION.

Decidedly the most interesting feature of the entire installation has been worked out by using the new umbrella-type generators. The fact that the station was designed with a view to using this new type unit, the first cost of which was in excess of the ordinary type of turbine, enabled the engineers to reduce greatly the installation labor cost, and at the same time they provided ample means for keeping down the operating charges. The particularly interesting point in the design of the umbrella-type unit is the extremely low speed required for operation, 75 r.p.m. All of the rotating parts in both the generator and water tur-

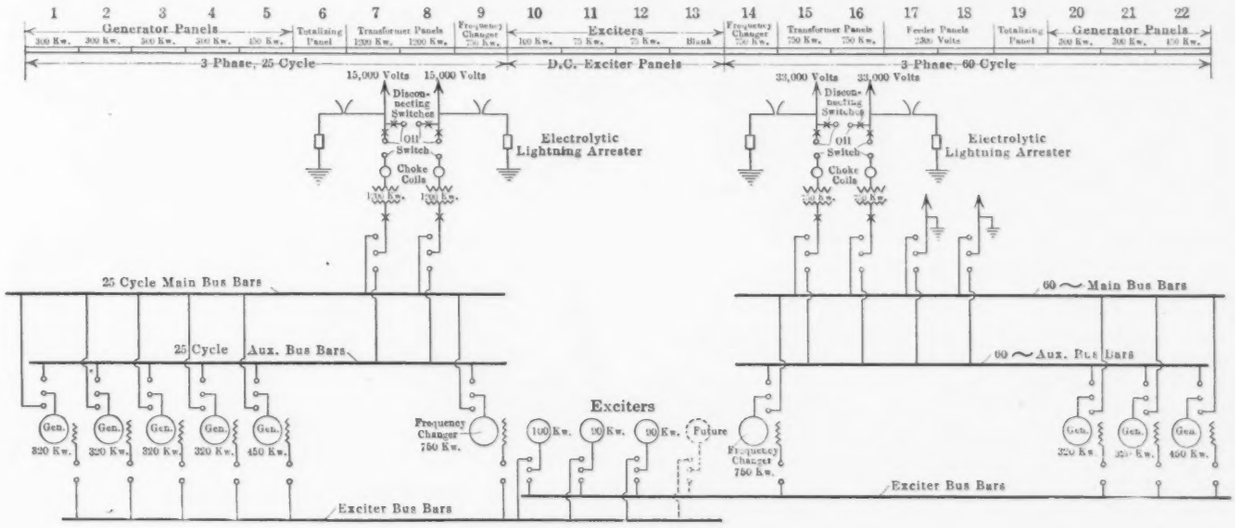


Fig. 6—Wiring Diagram.

bine below are supported on a roller thrust bearing at the top of the machine. This permits of easy inspection or access for necessary repairs. Another point of interest is that not only may the upper spider and rotor be removed by the electric crane, but the generator and foundations are designed so that the turbine shaft and runner may be lifted

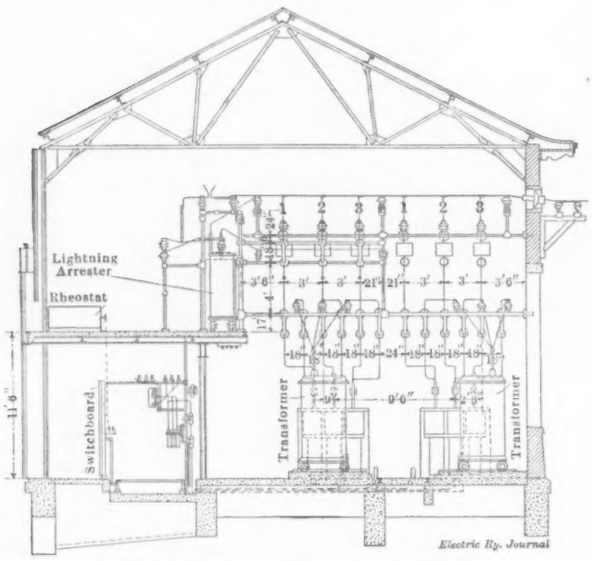


Fig. 8—Section of Transformer House.

out of the flume through the opening made by removing the rotor and lower spider.

The method of oiling the generator bearing is also interesting. An oil pump, gear-connected to the main driving shaft at the base of the generator, has been installed to force the oil to the thrust bearing at the top of the generator. The oil returns to the oil-supply tank at the base of the unit by gravity.

CONVERTING AND AUXILIARY APPARATUS.

The transformer annex contains a 22-panel, 2-in. blue Vermont marble switchboard, six 250-kw transformers and six 400-kw transformers, all of the Westinghouse water-cooled, oil-insulated type. They are mounted on small steel trucks so that in cases of emergency they may be handled readily by way of a narrow-gage track and turntable to a position under the electric crane. The water for cooling purposes is supplied from the headrace by a triplex motor-driven pump. For emergency purposes the transformers have been connected to the city water supply so that in case the pump should fail an automatic valve on the city connection will operate. The electrolytic lightning arresters, the generator rheostats and two oil circuit-breakers of the remote-control, hand-operated type are located on a gallery over the switchboard.

WIRING TUNNELS AND CONNECTIONS.

A continuous wiring tunnel built with reinforced-concrete walls and a steel-plate floor runs under the six umbrella-type generators. This not only gives free access to the varnish and cambric lead-covered cables and connections by means of grates located between the generators, but also furnishes access to the lower bearings of the generators. The bottom of this wiring tunnel is below the extreme high-water level, so that waterproofing was necessary on the concrete, and stuffing boxes had to be provided for the turbine shafts where they pass through the tunnel floor.

The cables are carried from this tunnel through the flume walls in 3-in. bituminized fiber conduit to a similar tunnel located along the rear of the switchboard, which is covered with wooden grating, and from this point the high-tension wires are carried overhead by means of pipe racks.

There are four outgoing three-phase transmission lines supported on two reinforced-concrete pole lines, one of which extends about 20 miles east and west from the plant and is built along the Illinois-Michigan Canal bank. The other connects with the pole line of the Chicago, Ottawa & Peoria Railway.

STATION OUTPUT.

Since October the total load has been increased as fast as the installation of the equipment would allow, and the station is now delivering 2870 kw. The addition of a 320-kva unit, the installation of which will be delayed until the total demand requires, will increase the equipment rating to 3190 kw. The generators, however, were all designed to allow for a 25 per cent overload, which will increase the permissible output to 3990 kw and exceeds the minimum horse-power to be obtained. In view of the fact that the water supply from the river is continually on the increase and that minimum power will be obtained only two months out of the year, the engineers took advantage of the situation by increasing the station equipment. The increased water supply in the Illinois River at this point is due to the Chicago Drainage Canal, for which it furnishes an outlet. Under a federal act the flow through the drainage canal may be increased up to a certain point, and this allowable increase will not be reached for some time to come.

The city water-supply pumping plant, which has been made a part of this hydroelectric station, was acquired under the terms of the transfer of the Consolidated company of Marseilles. While this adds, to a certain extent, to the total income of the station, the profits are small, owing to the fact that it is delivering only 950 gal. per minute through three directly connected motor-driven pumps.

The Marseilles plant was designed by Mr. C. W. Humphrey, consulting engineer, Chicago, under the direc-

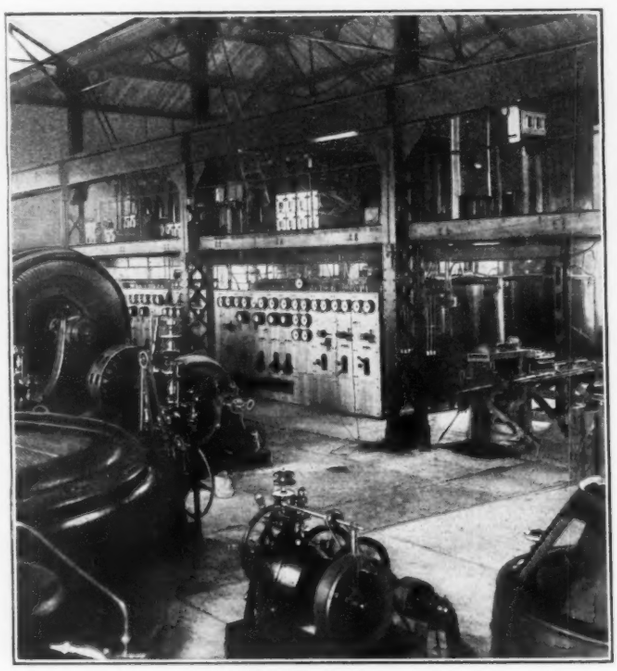


Fig. 9—Switchboard and Auxiliary Apparatus.

tion of Mr. H. E. Chubbuck, vice-president executive of the Illinois Traction System and the Western Railways & Light Company. The excavation, masonry and building construction work was handled by the L. E. Meyers Construction Company, Chicago. All the equipment was purchased and installed by the company under the supervision of Mr. Humphrey.

SUBSTATION OF THE JAMESTOWN LIGHTING & POWER COMPANY.

Changes in Generating Equipment Incident to the Acquisition of Lighting Company by Local Railway Interests.

By F. W. Bullock.

A SUBSTATION unusual in construction is that of the Jamestown (N. Y.) Lighting & Power Company. A year and a half ago Messrs. A. W. and S. B. Broadhead, the owners of the Chautauqua Traction Company and of the Jamestown Street Railway Company, purchased the property of the Jamestown Lighting & Power Company, which at that time consisted principally of some good aerial distribution circuits and a franchise. The generating station was old, inefficient and practically worthless as compared with modern standards. Inasmuch as there was sufficient excess generating equipment in the Chautauqua Traction Company's station to handle the Jamestown Lighting & Power Company's load, it was decided to utilize it and to install a substation to serve Jamestown. In the traction company's station, located at Jamestown, about three-fourths of a mile from the substation, are two Westinghouse 1500-kw, three-phase, 25-cycle, 380-volt turbo-generator sets. The emf of a portion of the energy from these is stepped up to 2200 volts and transmitted to the substation at that pressure.

The old Jamestown lighting company distributed energy for lighting at 2200 volts, 133 cycles, and for lighting and motor service at 250-125 volts, direct-current, on a three-wire system. When the reorganization was effected the elimination of the direct-current receiving apparatus was carefully considered. However, a large number of direct-current motors, particularly those for elevators and in industrial plants, were already installed, so it was decided to furnish direct-current motor service. At the same time 60-cycle, 2300-volt, three-phase service was desirable for general distribution. It was finally decided to install a 400-kw, 2300-volt synchronous motor-generator set, to change the frequency of the alternating-current energy from 25 cycles to 62.5 cycles and to install two 300-kw, 250-volt, three-wire rotary converters to supply energy to the direct-current motors. A frequency of about 60 cycles was decided on for induction motor loads, as the motors for 60 cycles cost less than do those of approximately the same power and speed for 25 cycles.

Synchronous motors were selected for driving the sets in order that the power-factor at the Chautauqua Traction Company's power house could be maintained at practically unity and so that proper frequency would be assured on the 62.5 cycle lines. Rotary converters were selected to furnish direct current, inasmuch as they offered the most efficient method of converting the alternating to direct current. The first cost of the method involving their use was lower than that of any other method, and less floor space was required. By the use of potential regulators as wide a voltage range can be obtained with a rotary converter as with a motor-generator set.

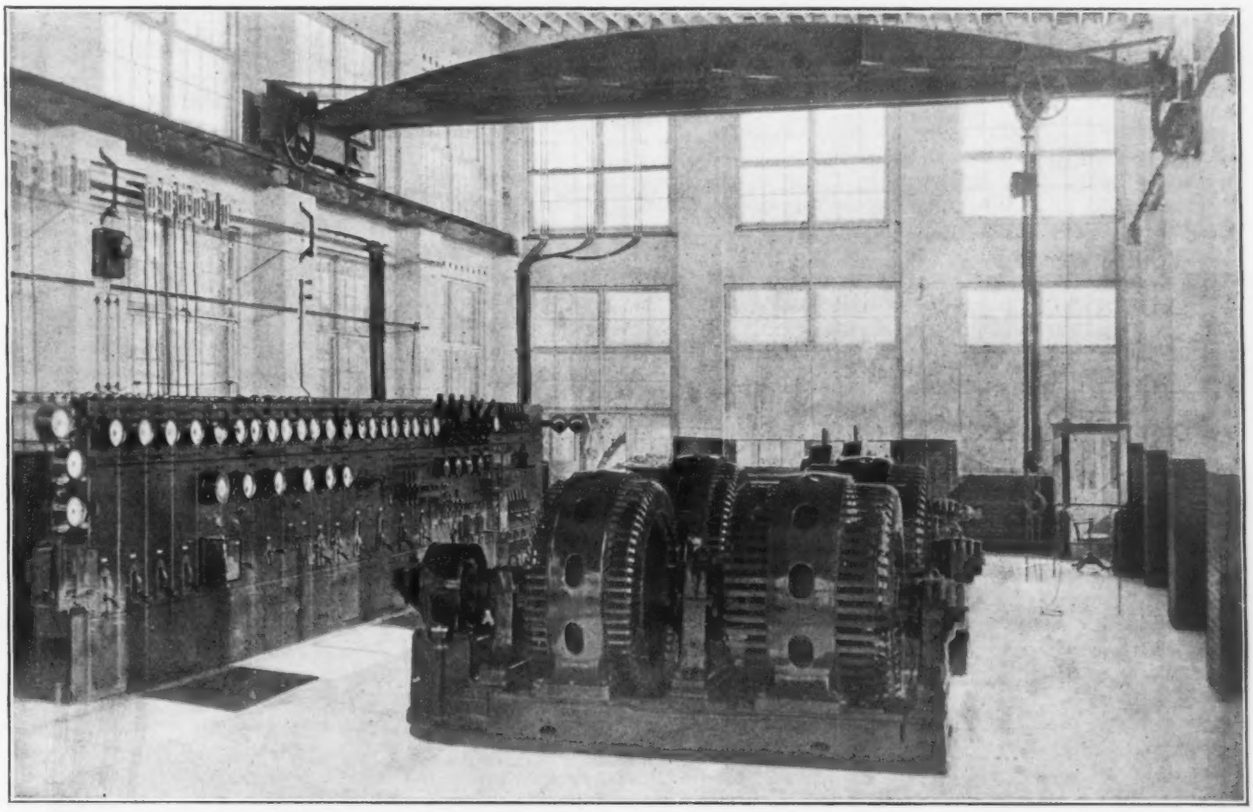


Fig. 1—Interior View of Substation.

In the traction company's station six 250-kva Westinghouse oil-cooled transformers, for raising the generated voltage of 380 to 2200 for transmission, were installed, together with a three-panel black slate switchboard for controlling the tie line. On the low tension side of the transformers a special 3000-amp circuit-breaker was installed. Time-limit relays have been furnished in connection with the breaker, so that it will never open except under extreme and prolonged overload. Disconnecting switches were inserted between the lines and each of the transformers so that the transformers can be cut out for repairs and also in order that either bank of transformers may be connected to either line or all transformers on one line.

Duplicate lines were built through Jamestown from the traction company's generating station to the substation. At no point are these lines on the same pole. This arrangement was adopted so that a fire or any other accident that might disable one line would leave the other still available

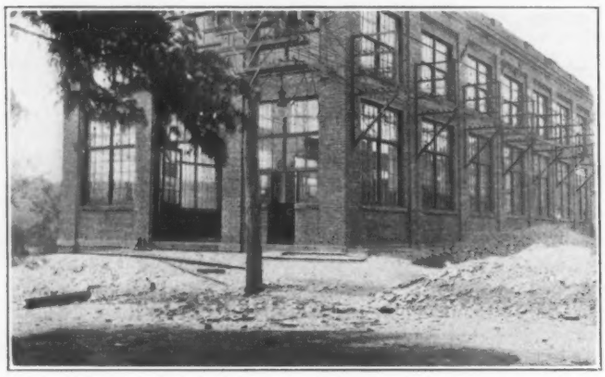


Fig. 2—Arrangement of Incoming and Outgoing Lines.

for service. One line is carried on the poles of the street railway and the other on the pole line belonging to the lighting company.

Within the substation, each tie line passes through a 300-amp Westinghouse oil circuit-breaker and to the 25-cycle, 2300-volt station bus. These breakers are equipped with no-voltage release coils. From this bus the energy is distributed to the different receivers through the nineteen-panel black, marine-finish slate switchboard.

The switchboard is located far enough from the wall to enable work to be done on it or on the induction regulators without disturbing other apparatus. In fact, the whole substation is laid out with the idea of getting at any piece of apparatus for inspection, cleaning or repairs with minimum disturbance of other apparatus. All moving apparatus has been placed above the floor line. Behind the switchboard there is a slot in the floor through which the motor-gen-

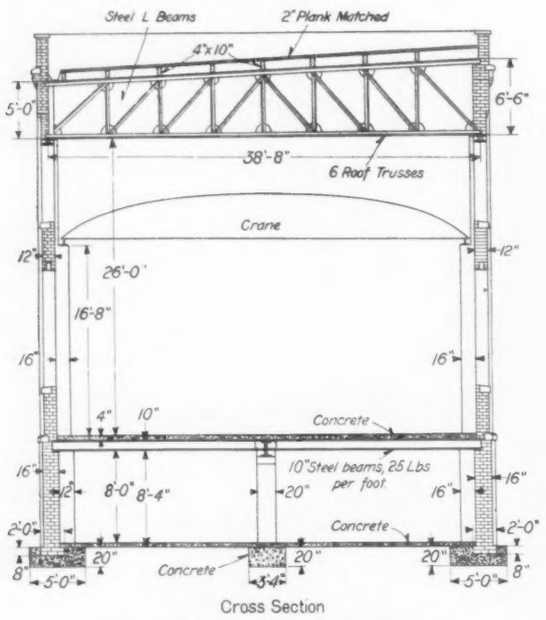


Fig. 3—Sectional View of Substation.

erator and rotary cables are carried to the basement. Watt-hour meters and recording wattmeters are used for ascertaining the total output and load conditions on both the direct-current and the alternating-current system. Three-phase static ground detectors are connected to both the 62.5-cycle and the 25-cycle system. All circuit-breakers are equipped with bell alarm attachments. A Tirrill regulator used in connection with the exciter maintains the generator voltage practically constant. The synchronous motors take their excitation from the direct-current sides of the rotary converters. Disconnecting switches have been placed on

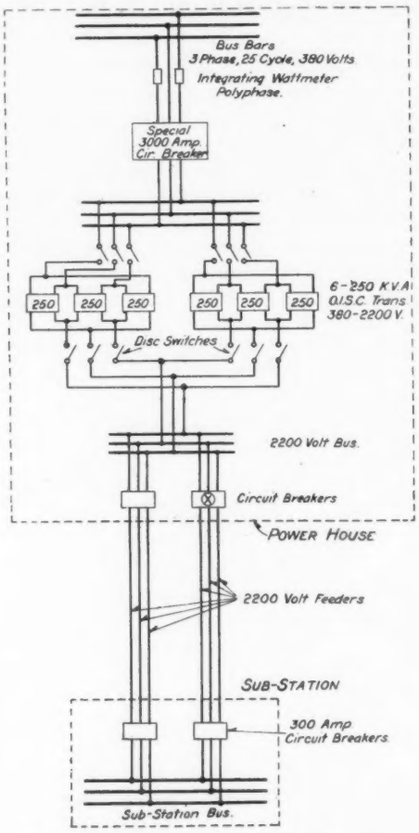


Fig. 4—General Diagram of the System.

the auto-transformers used for starting the motor-generator set so that the transformers can be taken out and repaired while the sets are running.

The motor-generators synchronize perfectly. The first set was installed by the manufacturer's engineer and the

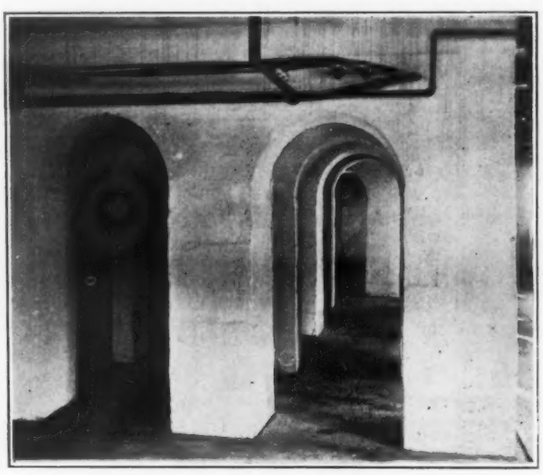


Fig. 5—Foundation for Motor-Generators.

second set was installed by the Jamestown company's force. When all was ready for operating, the sets were paralleled in 1.5 minutes on the first trial. The procedure in synchronizing is as follows: The starting switch on the motor is thrown to the starting position and the set is allowed to attain synchronous speed and then the field switch is closed.

If the synchroscope does not indicate synchronism, the field switch is thrown back to the starting position and the synchroscope is then permitted to revolve 2.5 times. Then the field switch is closed to the running position; the two machines will lock together, and the starting switch is finally thrown to the running position.

The transformers for the converters are connected in the interconnected star arrangement which provides for taking out the neutral for the three-wire system. The direct-current ammeter shunts are mounted on the sides of the rotary converters, making a very neat wiring arrangement. The voltage on the direct-current side of the converters is increased on increase of load by automatic induction regulators combined with auto-transformers.

ELECTRICAL EQUIPMENT OF A GREAT GROUP OF OFFICE BUILDINGS—VI.

Main Distribution System for Telephones and Signaling and Various Special Features of Wiring in the Buildings of the Prudential Insurance Company.

BY HENRY C. MEYER, JR., AND BASSETT JONES, JR.

A SERIES of articles have been devoted to the history of the installation of the Prudential Insurance Buildings at Newark, N. J., and to various construction details. The present instalment gives a short account of the main distributing system for telephones and signaling, particularly the methods of carrying the trunk cables.

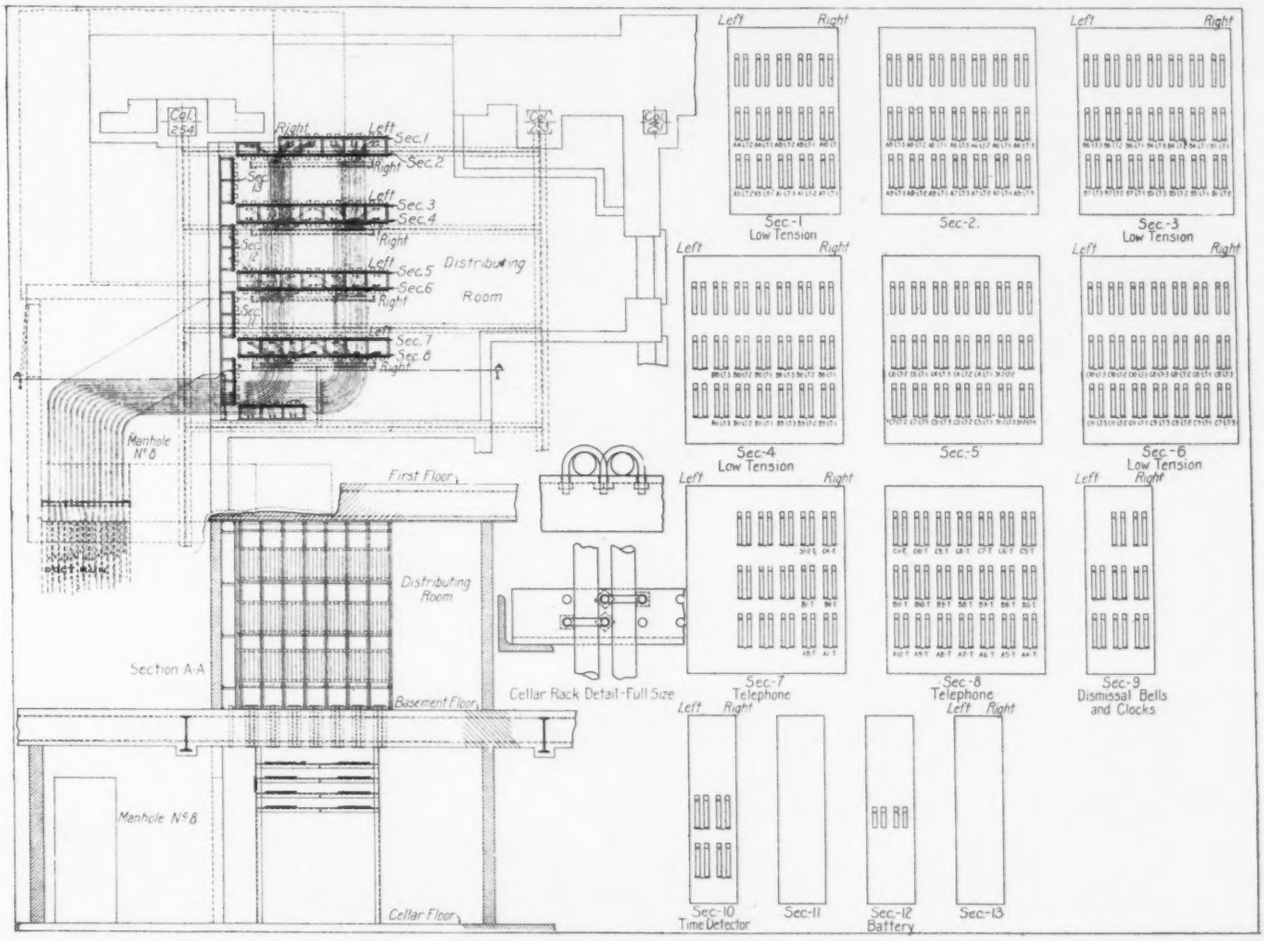


Fig. 60—Details of Rack No. 1.

Lighting energy for the substation is supplied through a 25-cycle transformer hung on the wall. Use is made of 250-watt tungsten lamps arranged so they can be thrown on the 110-volt direct-current three-wire system or on the three-wire alternating-current circuit fed by the above transformers. All lighting and small wiring is in conduit.

On the outside wall of the substation, back of the switchboard, an angle-iron bracket structure has been erected to support the incoming and outgoing wires. The arrangement really constitutes an out-of-door bus structure.

The foundations for the motor-generators and for the rotary converters are of unusual design in that they are hollow in the middle and have arched sides so that the machines supported will be thoroughly ventilated. A white paint is used on the interior of the substation above 6 ft. from the floor line. Below this line a dark-colored paint is used. The concrete floor is painted with a special concrete floor paint of high insulating qualities which provides a smooth clean finish.

MAIN DISTRIBUTING SYSTEM FOR TELEPHONES AND SIGNALING.

The main distributing system for telephones and signaling, or the low-tension system, as it is designed on the work, is centralized at two points, one south of Bank Street serving the Prudential Main and West Buildings, and one north of Bank Street serving the North Building, North Building additions and the Northwest Building. These two distributing centers, known respectively as rack No. 2 and rack No. 1, are tied together by trunk cables run through the main passage tunnel under Bank Street. Riser cables are run from rack No. 1 through the subway system in the cellar of the North Building addition and up the riser shafts to the several main-floor junctions. The riser cables from rack No. 1 to the floor junctions in the North Building and Northwest Building are run through the cellars and tunnels overhead as convenience dictated and hung by

special hangers constructed as shown in Fig. 59, so that any one cable can be entirely removed without interfering with any other cable. These cables pass through junction boxes at the foot of the riser shaft, where they are joined to the riser cables proper. These junctions were necessary

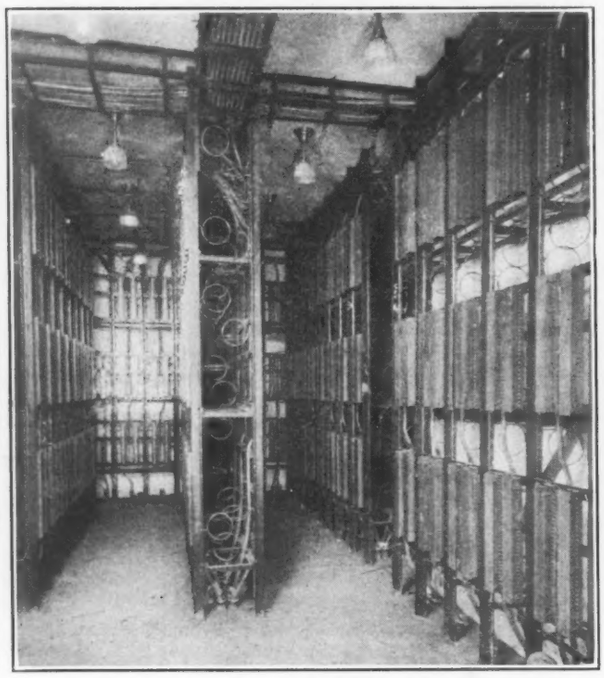


Fig. 61—Rack-Room No. 1.

on account of the fact that the horizontal runs in the cellars were first installed and connected to the old riser cables, after which new shaft cables were pulled in and bridged over pair by pair from the old junctions to rack No. 1. It was therefore necessary to have a dividing point at the foot of each shaft. In Fig. 65 is shown one of these riser junctions. The pull-box for the light and power cables running up the shaft may be seen at the left of the cut.

SPECIAL CABLE FEATURES.

A view of rack No. 1 is shown in Fig. 61. Fig. 60 shows the working drawing of the lay-out of rack No. 1. In Figs. 60 and 61 may be seen the rising cables to the North Building addition passing through the rack-room floor. The pipe nipples there shown extend only to the ceiling of the cellar space beneath the rack-room known as manhole No. 8 (see Fig. 9), the cables being run along this ceiling in long steel pans hung under the rack sections. These pans join at one end to a cross-pan which serves to carry the cables to a steel pull-box capping the end of the subway where it enters this manhole. This special arrangement was made to avoid the main elevator trunk pipes and other pipes passing through the manhole. A view illustrating the method of bringing the trunk cables and overhead cables into rack-room No. 1 is shown in Fig. 62.

The method of carrying the trunk cables in the Bank Street tunnel is shown in Fig. 63. A removable cover of metal surrounds the cables on all exposed routes, as shown.

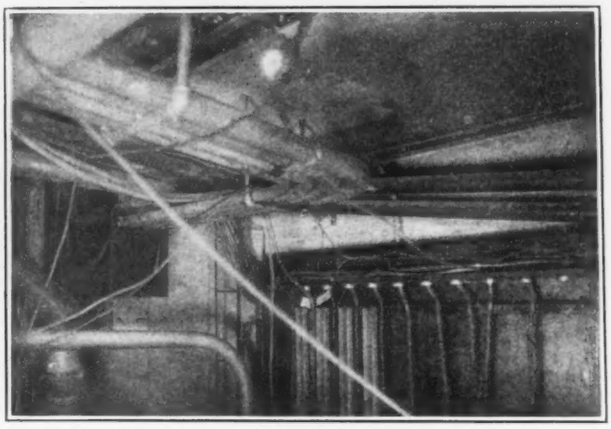


Fig. 65—Riser Junction.

A view of rack-room No. 2 is shown in Fig. 64. At the left of the cut can be seen part of the frame of the old main junction now superseded by rack No. 2, together with such of the old wires coming to this junction as had not been cut over onto rack No. 2 at the time the photograph was taken. This view illustrates the difficulties overcome in the course of reconstructing the old equipment. The rack was built gradually in sections as space could be made for it by pulling out the old material.

Fig. 66 shows one of the existing riser junctions in the old buildings during the progress of reconstruction. Beside it is a temporary transfer junction fastened to the wall. The main-floor junctions at which the riser cables terminate are shown in Fig. 57.

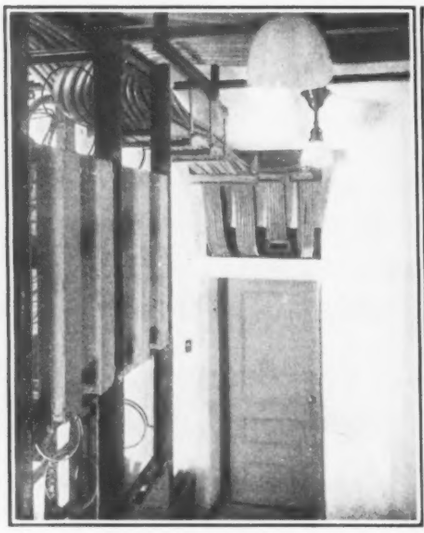


Fig. 62—Entry of Cables to Rack No. 1.

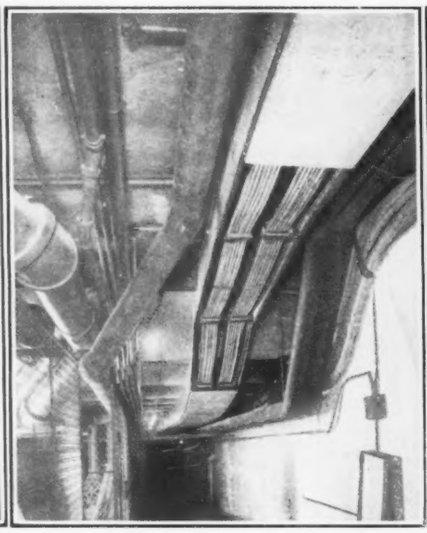


Fig. 63—Trunk Cables for Signal System.

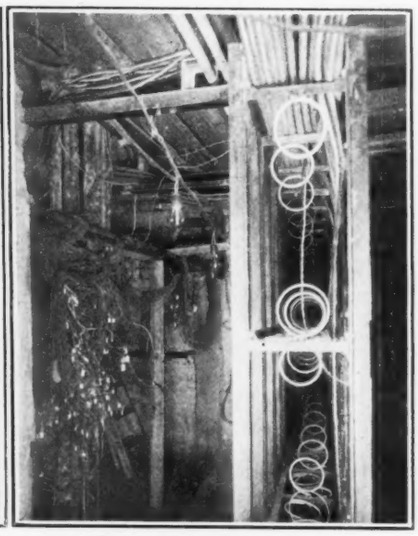


Fig. 64—Rack-Room No. 2.

MULTIPLICITY OF THE SERVICE DEMANDS.

The main racks are divided into two separate sections for telephones, annunciators, etc., clocks, dismissal bells, battery service, fire alarms and watchman's time detectors. Separate rising cables and trunk cables for these several services are used, the rising cables for telephones and annunciators terminating in corresponding separate sections of the floor junctions. The street-service telephone junction is in the cellar of the Prudential Building and is connected to the main racks by trunk cables. A general diagram of the riser system is shown in Figs. 53 and 54. Separate lines for testing and for portable telephones for use while connections are being made connect the racks with all floor junctions. The rising clock cables and dismissal bell cables are run through separate smaller junctions on each floor, the dismissal bells being mounted on the junction covers. Clocks have individual outlets connected to these junctions.

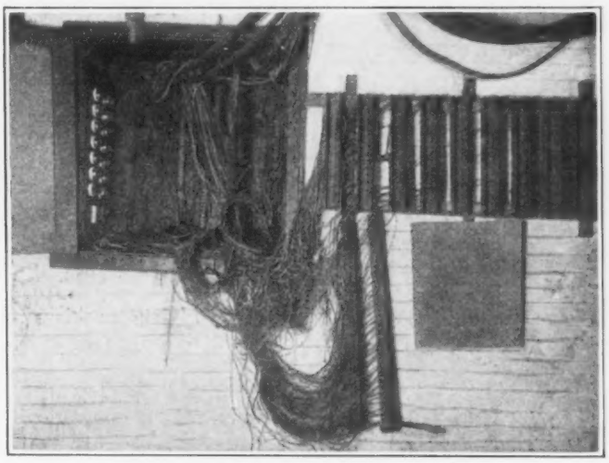


Fig. 66—Riser Junction. Transfer in Progress.

NIAGARA FALLS MOTOR-DRIVEN PUMPING STATION.

The water supply of the city of Niagara Falls, N. Y., is obtained from the Niagara River about 4 miles above the cataract, passed through settling basins and delivered to the street mains by motor-driven centrifugal pumps. A 48-in. intake pipe extends into the center of the river, opening into the raw-water well beneath the station, from which the three low-pressure pumps deliver into the new purification plant. This triplicate low-pressure pumping equipment comprises three 40-hp, 440-volt motors, driving, at 735 r. p. m., centrifugal pumps with 15-in. suction and 10-in. discharge, and capable of delivering 4200 gal. of water per minute. From the purification plant the water is returned to the treated-water basin, over which are mounted the high-duty pumps. There are six of these 400-hp units, each pump delivering 4200 gal. per minute against a suction lift of 13 ft. and a discharge head of 73 lb. per sq. in. By an arrangement of valves and cross-headers, fire pressure can be supplied to the mains by coupling pairs of the centrifugal pumps in series. All of the main valves are hydraulically controlled, but can be manipulated by hand-wheels if required. Ordinarily the plant is capable of delivering 13,000,000 gal. of water per day.

Energy at 13,000 volts is purchased from the Niagara Hydraulic Power & Manufacturing Company, at the rate of $8 per hp-year, up to the present requirements of 800 hp. Auxiliary connection is also made to the lines of the Niagara Falls Power Company for emergency use in case of interruption to the regular channel of supply. For this privilege the city of Niagara Falls pays the latter company several hundred dollars a year. The main oil switches connecting the lines of the two companies to the pumping-station bus are so interlocked that one cannot be closed unless the other has been opened, so that there is no possibility of accidentally interconnecting the two systems. The three oil-insulated, water-cooled transformers, totaling 625 kw, used for stepping down from the transmitted potential, 13,000 volts, to the station pressure, 440 volts, are contained in separate concrete cells beneath the switchboard gallery on which are mounted the starting panels, switches, etc. Each power panel is equipped with a curve-drawing wattmeter for recording the energy consumed by the station pumps. Venturi meters in the main pumping lines indicate the water delivered by the plant. The transformers, motors and centrifugal pumps for the Niagara Falls water-works station were furnished by the Allis-Chalmers Company, Milwaukee. Mr. P. J. Keller is president of the Niagara Falls board of water commissioners, and Mr. W. D. Robbins, as engineer, designed and supervised the construction of the new station.

ON GRAVITATION.

BY ALBERT C. CREHORE, PH.D.

IN the previous paper on "An Analysis of the Cause of Gravitation and Comparison with the Gravitational Constant" it was assumed that the action of the revolving magnetic sheets upon the negative corpuscles was very small as compared to the effect upon the positive sphere, and it was stated that I had not been able to give a proof of this. The greatest difficulty in calculating the attraction of one atom for another is due to the fact that no general solution for obtaining the force exerted by one moving electrical charge upon another true for all velocities up to the velocity of light is known. There are reasons which seem convincing that lead me to believe that the corpuscles within an atom are revolving around their orbits with the approximate velocity of light, and, therefore, it seems necessary to find formulæ which are good up to this velocity before we can calculate the true value of the gravitational constant. The peculiar or unusual manner of making the calculations in the former paper was forced by the necessity of working at nearly the velocity of light.

The general solution of the problem of two electrical charges moving in any way with reference to a medium in space for *velocities slow compared with that of light* was given in the *Philosophical Magazine* of 1881 by Sir J. J. Thomson. If it can be shown that two separate atoms each with slowly moving corpuscles attract each other gravitationally, as pointed out in the former paper, and that the attraction is mainly due to the action of the negative corpuscles in the one atom attracting the positive electricity in the other to a much greater extent than the revolving corpuscles, and that the forces upon these moving corpuscles may be neglected, then it is easier to believe that this may also be true up to the velocity of light very nearly.

In this paper a proof is given, based directly upon the general solution given by Thomson, that it is entirely possible and even probable that the force upon a revolving negative corpuscle is negligible, as was assumed in the previous paper.

Consider the simple case of two electrical charges e and e', each revolving, say, in the counter-clockwise direction in circles of radii a and a' with constant angular velocities ω and ω' respectively in the plane of the paper. Let r be the distance between the centers of their orbits and R the distance between the charges. It is required to find the average force exerted upon the first charge by the second charge when taken over a long time.

As the proof here given is based directly upon Sir J. J. Thomson's paper, it seems proper to quote his words. In one part of the paper he gives the forces upon the first sphere with a charge e due to a second sphere with a charge e', each moving in any direction in space with velocities q and q' respectively relative to a medium, and sums up as follows: "From this we see that if $\dot{q}_1$ be the acceleration of the second sphere, the forces on the first sphere are an attraction $\frac{\mu e e'}{3R^2} q q' \cos \varepsilon$ along the line joining centers, a force $\frac{\mu e e'}{3R} \dot{q}_1$, in a direction opposite to the acceleration of the second sphere, and a force $\frac{\mu e e'}{3} q_1 \frac{d}{dt}\left(\frac{1}{R}\right)$ in a direction opposite to the direction of motion of the second sphere." When q and q' are each zero it is seen that the three component forces above mentioned vanish, but there still remains the electrostatic repulsion, if the charges are each negative. Thus there are in all four component forces, F_1, F_2, F_3, and F_4, upon the first sphere due to the second sphere. The angle ε denotes the angle between the directions of motion of the two spheres. The values of the four forces are

$$F_1 = \frac{e e'}{K R^2}, \text{ a repulsion along the line joining centers.} \quad (1)$$

$$F_2 = \frac{\mu e e'}{3R} q q' \cos \varepsilon, \text{ an attraction along the line joining centers.} \quad (2)$$

$$F_3 = \frac{\mu e e'}{3R} \dot{q}_1, \text{ a force in a direction opposite to the acceleration of the second sphere.} \quad (3)$$

$$F_4 = \frac{\mu e e'}{3} q' \frac{d}{dt}\left(\frac{1}{R}\right) \text{ a force in a direction opposite to the direction of motion of the second sphere.} \quad (4)$$

Let O and O' represent the centers of the orbits of the first and second spheres respectively. Let the charge e be located at A_0 and e' at B_0 when the time is zero, and at A and B respectively after a time t. The angle $A_0 O A = \omega t$, and $B_0 O' B = \omega' t$. The angle ε between their directions of motion at any instant is $\varepsilon = (\omega' - \omega) t$, and the force

$$F_2 = \frac{\mu e e'}{3R^2} q q' \cos (\omega' - \omega) t \text{ along the line } R \quad (5)$$

When the distance $O O' = r$ between the centers of the orbits is large compared to the radii of the orbit a or a', which is the case when the atoms are outside of molecular range, the direction of the line R joining the charges is sensibly parallel to the line r joining the centers O and O'.

Since we are only concerned with the average value of the force over a long time, it is evident from the expression (5) that the average value of the second component force is zero, and it is not, therefore, necessary to consider this component further.

The direction of the third force varies completely around the circle, and we are only concerned with the component along the line r. The force (3) is resolved along the line r by multiplying by $\cos \omega' t$. The acceleration of e' in its circle is $\frac{q'^2}{a'}$, and we have, since $q' = a' \omega'$,

$$F_3 \cos \omega' t = \frac{\mu e e'}{3R} a' \omega'^2 \cos \omega' t, \text{ along the line } r. \quad (6)$$

From this we see that the average value of the third component over a long time vanishes and need not be considered further.

It is the fourth component which requires attention. If we take R and r as sensibly parallel, we see that

$$R = r - a \cos \omega t + a' \cos \omega' t \quad (7)$$

$$\text{Hence } \frac{d}{dt}\left(\frac{1}{R}\right) = \frac{-a \omega \sin \omega t + a' \omega' \sin \omega' t}{\{r - a \cos \omega t + a' \cos \omega' t\}^2} \quad (8)$$

The fourth component force (4), being in a direction opposite to the direction of motion of the second sphere, may be resolved along the line $O O'$ by multiplying by $\sin \omega' t$. Writing $F = F_4 \sin \omega' t$, and substituting (8) in (4), we obtain

$$F = \frac{\mu e e'}{3} a' \omega' \sin \omega' t \frac{[-a \omega \sin \omega t + a' \omega' \sin \omega' t]}{[r - a \cos \omega t + a' \cos \omega' t]^2}. \quad (9)$$

This expression represents the instantaneous value of all the forces, except the first component due to the electrostatic charge acting upon the first sphere due to the second sphere, resolved along the line $O O'$. It is required to find the average value of this force over a long period. The average value is equal to $\frac{\int_0^T F \, dt}{\int_0^T dt}$. If F' denotes this force, we have

$$F' = \frac{\mu e e' a' \omega'}{3} \int_0^T \frac{[-a \omega \sin \omega t + a' \omega' \sin \omega' t]}{[r - a \cos \omega t + a' \cos \omega' t]^2} \sin \omega' t \, dt \quad (10)$$

For obtaining the expressions which follow for the values of the above integral under different conditions I am indebted to Prof. James McMahon. The force F' has different values, depending upon the relative values of the angular velocities ω and ω' of the two corpuscles. That is to say, the force *does* depend upon the state of motion of each corpuscle.

If ω' is not an exact multiple of ω, that is, if $\frac{\omega'}{\omega}$ is not an integer, then

$$F' = \frac{\mu e e' a'^2 \omega'^2}{6 r^2}\left\{1 + \frac{3(a'^2 + 2a^2)}{(2r)^2} + \frac{10(a'^4 + 6a'^2 a^2 + 3a^4)}{(2r)^4} + \frac{35(a'^6 + 12a'^4 a^2 + 18a'^2 a^4 + 4a^6)}{(2r)^6} + \ldots\right\} \quad (11)$$

When ω is an aliquot part of ω', the expression in (11) does not apply. The cases when $\omega' = \omega$, $\omega' = 2\omega$, $\omega' = 3\omega$, etc., will, therefore, be given separately.

First, when $\omega' = \omega$ the value of F' becomes

$$F' = \frac{-\mu e e' a' \omega'^2}{3r}\left\{\frac{1}{2}\frac{a - a'}{r} + \frac{3}{8}\left(\frac{a - a'}{r}\right)^2 + \ldots\right\} \quad (12)$$

Second, when $\omega' = 2\omega$, the following terms must be added to the expression inside the brackets in (11).

$$-\frac{a}{a'}\left[\frac{a}{2r} + 4\left(\frac{a}{2r}\right)^3 + 15\left(\frac{a}{2r}\right)^5 + \ldots\right] \quad (13)$$

Third, when $\omega' = 3\omega$, add to the expression inside the brackets in (11)

$$-\frac{a}{a'}\left[\left(\frac{a}{2r}\right)^2 + 5\left(\frac{a}{2r}\right)^4 + 21\left(\frac{a}{2r}\right)^6 + \ldots\right] \quad (14)$$

Fourth, when $\omega' = 4\omega$, add as above

$$-\frac{a}{a'}\left[\left(\frac{a}{2r}\right)^3 + 6\left(\frac{a}{2r}\right)^5 + \ldots\right] \quad (15)$$

When $\omega' = 5\omega$, add $-\frac{a}{a'}\left[\left(\frac{a}{2r}\right)^4 + \ldots\right]$, and when $\omega' = 6\omega$, add $-\frac{a}{a'}\left[\left(\frac{a}{2r}\right)^5 + \ldots\right]$

APPLICATION TO AN ATOM

It is more difficult to interpret the solution of equation (10) because it is in the form of series which differ for differing values of the angular velocity ω of the charge e than it would be if a continuous function of the ratio ω'/ω. Consider, first, the case of two negative charges e and e'. Let the angular velocity ω' of the charge e' remain fixed while the charge e is supposed to increase gradually from zero up to ω'. If the ratio $\frac{\omega'}{\omega}$ is denoted by γ, this ratio then decreases from infinity when $\omega = 0$ to unity when $\omega = \omega'$. Physically we can see that the force F' should be a continuous function of the ratio γ; but the series are only given above, when $\gamma = 1, 2, 3$, etc. Again, suppose that the negative charge e' is within a sphere of positive electricity of equal amount as in a neutral atom. The component force F_1 in equation (1) is then exactly balanced by that due to the positive electricity, so that the whole force upon the charge e, revolving at angular velocity ω, due to the distant corpuscle e', revolving within an equal positive sphere at velocity ω', is given by the value of F' in the different expressions (11) and following according to the ratio γ.

ATTRACTION ON THE POSITIVE SPHERE

If the charge e were at rest, so that $\gamma = \infty$, equation (11) gives the total force upon the charge e along the line $O\,O'$. Since a and a' are very small compared with r, all terms except the first of the series may be neglected, and we have, after substituting $q' = a'\,\omega'$,

$$F' = \frac{\mu\, q'^2}{6}\,\frac{e\,e'}{r^2}. \qquad (16)$$

If the charge e' is negative, being a corpuscle, and e is positive, being the positive charge at rest surrounding the negative corpuscle, the force F' is negative and is an attraction. Neglecting for the present the force upon the negative corpuscle e, or taking it to be small, we see that equation (16) gives the well-known law of gravitation. The force varies not only directly as the product of the masses and inversely as the square of the distance, but also directly as the square of the velocity q' of the attracting corpuscle e'. This is in agreement with the result given in my previous paper equation (12) with the exception of the constant term. One reason for a difference in the constant term is that the positive charge was there taken as a cube instead of a sphere; but the principal difference is due to the fact that the corpuscle e' was there supposed to be moving with the approximate velocity of light, whereas here it is known that the formula (16) cannot be applied up to this velocity.

FORCE ON THE REVOLVING NEGATIVE CORPUSCLES.

Before we can tell which expression to use, (11) and following, for the revolving negative corpuscle e, it is necessary to know something about the ratio $\gamma = \frac{\omega'}{\omega}$. Without repeating the reasons for thinking that all corpuscles in rings within an atom travel at approximately the velocity of light, which have been given in the previous papers, I shall assume that this is the case here, as it represents the best evidence on the subject as it seems to me. If this is true the ratio of $\frac{\omega'}{\omega}$ is more nearly equal to unity than any other assignable value. It must not be understood that I take it as exactly unity, for it will vary in the different rings within the same atom if the velocity is nearly equal to that of light, and will sometimes be more and sometimes less. There is sufficient justification, however, for examining the expression (12), which gives the force when $\omega' = \omega$, and $\gamma = 1$. Neglecting all terms except the first, as being small compared with the first when r is much greater than either a or a', we have

$$F' = \frac{\mu\, q'^2}{6}\,\frac{(a' - a)}{a'}\,\frac{e\,e'}{r^2}. \qquad (17)$$

By this we see that, if the radii a and a' of the rings of corpuscles in the two atoms are equal, the force F' vanishes, and there is neither an attraction nor repulsion upon the revolving corpuscle e. There is, however, an attraction (16) upon the positive sphere, and in this particular case we find a complete explanation of the law of gravitation as between two atoms in the manner outlined in the previous paper, the force being due to the attraction on the positive electricity, the negative corpuscles being neglected.

If a is not equal to a' (17) shows that the force F' may be an attraction or a repulsion according as a is greater than or less than a' respectively. Since an average atom contains a number of rings of corpuscles of different radii, to obtain the effect of one such atom upon another with any definiteness it is necessary to know exactly how the rings are distributed. It is evident, however, that it is entirely possible that the resultant force due to the whole system of rings upon each other *may be* very small as compared with the attraction on the positive sphere. The ratio of (17) to (16) gives $(a' - a)/a'$. An average ring in one atom would be likely to be repelled by the rings in the second atom which are greater in diameter than itself as much as it is attracted by those smaller than itself, and so the total effect upon the negative corpuscles be very small.

CONCLUSION.

It will certainly appear to some that the assumption that ω' is nearly equal to ω is entirely unwarranted, and is improbable on the theory of probabilities. This would seem to be true if the velocities of the corpuscles were some hundreds of times less than the velocity of light, as some suppose. But if they approach the velocity of light this furnishes a natural reason why their velocities are nearly the same, the limit being imposed by the nature of the medium common to them all. The fact that an expression for gravitation may be directly derived from the solution for two moving charges as given by Sir J. J. Thomson in 1881, based upon Maxwell's electromagnetic theory, by making the one assumption that the velocities of the corpuscles within an atom approach very close to that of light seems to be an additional reason why it may be considered as the probable truth.

The speed with which gravitation travels is not brought out so clearly in the foregoing proof of the law of gravitation as it was in the previous paper. The paper of Thomson, however, gives the solution for the motion of a charge in any curve, and the expression for the magnetic force at any point is given by formula (2) in the former paper. Oliver Heaviside does not give in his papers the details of the method of derivation of his more general formula (1) of the preceding paper, but it is understood that this applies to motion in a curve, the acceleration not being zero, the axis being merely taken along the direction of motion at some particular instant. This makes the velocity of transmission indefinitely greater than the velocity of light in the manner pointed out in my first paper; or perhaps the better way to look at it is that there is no velocity of transmission, the force of gravitation being already there without the need of transmission.

If nothing else has been accomplished, it is hoped that I have sufficiently emphasized the importance of obtaining a solution of the problem at the approximate velocity of light. A determination of the positions and velocities of the corpuscles and the exact description of the fields surrounding them is perhaps the most important problem awaiting solution at the present time.

Central Station
Management, Policies and Commercial Methods

USING MOVING-PICTURE FILMS TO POPULARIZE CENTRAL-STATION SERVICE IN SMALL TOWNS.

Recently the Chippewa Valley Railway & Light Company has made use of a moving-picture film entitled "Every Husband's Opportunity" to popularize the use of electric cooking and heating appliances in Eau Claire and Chippewa Falls, Wis. The picture is generally similar to that first produced for the Commonwealth Edison Company, Chicago (described in the *Electrical World*, June 1, 1911). It depicts a young couple's troubles with their servant and their old-fashioned kitchen and laundry, but closes happily with a complete electrically equipped household. The scenes were posed in a small community so as to be more applicable to the average central-station situation than was the original Chicago company's film. The Essanay Film Company, Chicago, made the pictures for the General Electric Company, which loans copies of the film to central stations free of charge.

Mr. A. E. Peirce, of the Chippewa Valley company, arranged with the local nickel shows to exhibit the picture free of charge, in return for the electric-light company's offering prizes to be distributed to each holder of a paid admission. A prize was awarded each evening, and these prizes consisted of the winner's choice of percolators, toasters, irons, etc. The central station advertised the event in the local papers so that at each performance the picture shows were filled to overflowing, to the satisfaction of both proprietor and company. Much new interest in electric devices is traceable to this exhibition, according to Mr. Peirce, and at least two house-wiring contracts were directly due to it, for these householders won electric prizes and couldn't use them until they had ordered the wiring done. The only cost to the central station was for the prizes and newspaper advertising.

In other localities where the same film has been exhibited the central station has arranged with the picture show for a large number of tickets at half price, to be distributed among its present and prospective customers. Where necessary some rebate is allowed on the theater's bill for energy.

INSTRUCTIONS TO METER READERS.

The Eastern Wisconsin Railway & Light Company has issued the following instructions to its meter readers at Fond du Lac, Wis.

"Our meter statements must be secured in the shortest possible space of time, but accuracy must not be sacrificed for speed.

"When taking statements you must remember especially our policy in handling our consumers. We want you to show them by your manner that you, as our representative, are fully alive to the value of their business, but we don't want you to waste valuable time visiting with them or attempting to handle any of the business with which you are not concerned.

"If a consumer wants the statement of his meter, give it to him at once, but do not attempt to figure his bill.

"If the consumer has a complaint to make, note it down for a report when you return to the office.

"If he desires any other information or service refer him as considerately as you possibly can to the office, where his wants will receive careful attention.

"Always record the meter statement while you are at the meter. Do not attempt to carry it in your head until you are outside the building.

"Do not strike matches or carry open flames in basements filled with rubbish. You cannot be too careful in this respect, as by such carelessness a very small fire might cost us in damages a great deal more than the entire expense of reading all our meters for a considerable period.

"Do not attempt to force your way into vacant premises or premises where the occupants are away.

"Remember that every man's house is his castle and you have no business entering it except with his consent.

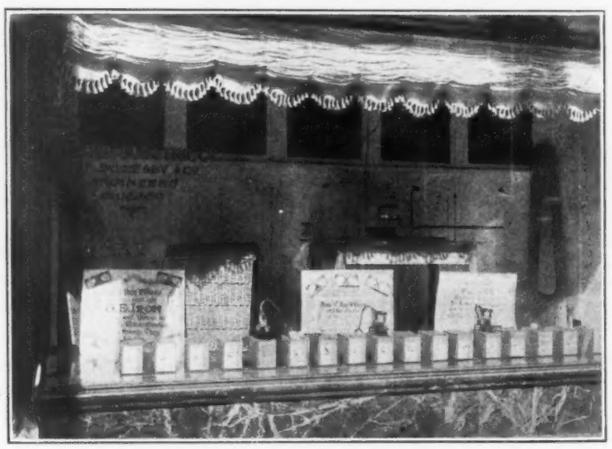
"Keep your eyes open for meters damaged in any way, meters improperly set, not supported, etc., and make a written report to the accounting department of all such cases.

"Report your statements to the office at the close of each day's work."

At Fond du Lac the meter readers deliver bills to customers, and when doing so, according to Mr. F. J. Maxwell, auditor for the company, are cautioned to "be sure that the right bill is left at the right place. Nothing, of course, will more quickly arouse a consumer's suspicion of the accuracy of the company's methods than to receive a bill which belongs to his neighbor. He will argue that it is just as easy for the meter reader to get mixed in taking meter statements as to deliver the wrong bills. Each bill has cost a certain amount of money to make out, and any carelessness in delivering bills will result in loss to the company and annoyance to its consumers."

A WINDOW DISPLAY THAT SOLD EIGHTY-SEVEN IRONS IN A MONTH.

Without assistance of salesmen or other campaigning the window display of the Mobile (Ala.) Electric Company, shown in the accompanying illustration, sold eighty-seven electric irons at $4 each during the month of September last. As a special attraction to purchasers, Mr. R. E. Flower, contract agent for the company, had ordered from



A Successful Window Display of Electric Irons.

a local planing mill a number of the convenient ironing boards shown. These comprised a standard-length board separated by a substantial spacing block from a small sleeve-board. Either side could be used as the base while the other served as the ironing surface. Such boards ordinarily cost $1.25 in the stores, but the Mobile company

sold these at the manufacturing cost, 50 cents, to those who bought irons. The irons alone were $3.50; the iron and board cost $4.

Decorated with dollar bills and coins the cards shown in the window read as follows: "Four of these 'Williams' will buy a latest type electric iron, and we will throw in one of the Mobile Electric ironing boards. They are dandies." "Three of these 'Williams' and five 'dingles' will buy a latest-type iron, but then, of course, we can't throw in the board." "If you are from Missouri and have to be shown, we will allow you ten days' trial. If you like the iron at the end of that time, send us one of these"—accompanying which was a check made payable to the electric company. Several ironing boards, a table and iron in use, a laundry basket, etc., made up the "props" for the window display.

ELECTRICAL MAINTENANCE COSTS.

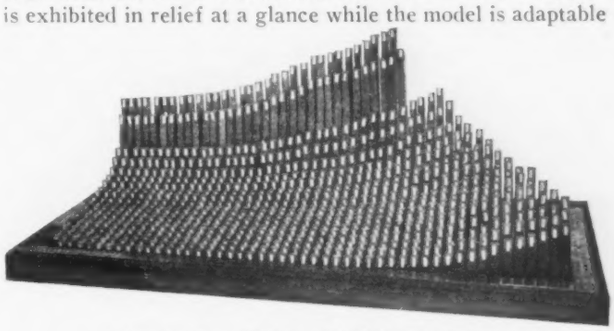
Comparisons of the cost of maintenance among different generating stations are seldom of value unless interpreted in the light of full equipment and operating details. The vicissitudes of service in a single station may result in two or three times the cost of repairs in a given year as contrasted with the previous twelve months in the same installation, but as a general rule these expenses form only a small proportion of the total cost of labor, fuel and supplies under a single roof. It is significant that certain ratios tend to run through the records of steam and electrical machinery repairs, however, even in considering a large number of plants, and it is noteworthy that in the great majority of cases the cost of electrical maintenance for a practically equivalent rating in steam machinery is usually much below the expense of upkeep in the latter section of the station.

Taking a few typical plants of the steam turbine variety, the costs of steam and electrical repairs for a recent year were as follows: Station A, rating 2500 kw—Steam equipment repairs, $1,555; electrical, $109; total station production cost, $51,800. Station B, rating 3000 kw—Steam repairs, $2,252; electrical, $600; production cost, $71,700. Station C, rating 1500 kw—Steam repairs, $1,258; electrical, $374; production cost, $94,499. In a few plants operated by reciprocating engines the corresponding costs for a yearly period were as follows: Station D, rating 5200 kw—Steam repairs, $3,712; electrical, $1,768; production cost, $69,000. Station E, rating 2000 kw—Steam repairs, $1,764; electrical, $95; production costs, $47,700. Station F, rating 1250 kw—Steam repairs, $1,804; electrical, $171; production costs, $24,600. Similarly, in stations operating mixed engine and turbine equipments, the ratio of steam to electrical repairs is greatly in favor of the latter. Thus: Station G, rating 1839 kw—Steam repairs, $981; electrical, $51, production costs, $23,400. Station H, rating 1195 kw—Steam repairs, $934; electrical, $33; production costs, $21,400. Station I, rating 4460 kw—Steam repairs, $4,159; electrical, $2,705; production costs, $72,200. Station J, rating 1082 kw—Steam repairs, $3,793; electrical, $1,064; production costs, $29,900.

These figures, taken practically at random from the operating records of a large number of well-managed plants, show that in the modern central station the cost of maintenance is as a rule only a small part of the total expense of operation, indicating in some measure at least the great reliability of the equipment now in service. In general, it appears that an allowance of from $1 to $1.50 per kilowatt of station rating per year is ample to cover the cost of upkeep of such steam and electrical equipment. The apparatus covered in the above figures included, under plain steam-engine plants, directly connected generating units, boilers, fuel-handling apparatus, piping and auxiliaries, but repairs to the station building were not covered in the data presented. Similarly, in the turbine and mixed plants, all the equipment is included in the costs given, from the coal pile to the generator, and thence under the electrical classification are covered wiring, switchboard apparatus, generators and accessories. The low cost of electrical repairs is a striking evidence of the thoroughness of design and quality of shopwork now characteristic of this class of equipment.

MOVABLE-PEG MODEL OF WHOLESALE RATES.

An interesting model to indicate at a glance the rates for electrical energy under a certain schedule and under varying conditions of service has been prepared by the Commonwealth Edison Company, of Chicago, under the direction of Mr. E. W. Lloyd, general contract agent, who is also chairman of the rate research committee of the National Electric Light Association. This model, which is illustrated herewith, is based on the company's rate sheet for the wholesale price of direct current at various maximum kilowatts of demand and load-factors. The different rates are indicated by movable blocks of wood set in receptacles in a horizontal base with a margin indicating the various maximum demands and hours' use on which the individual rates are calculated. Thus the whole schedule is exhibited in relief at a glance while the model is adaptable



Movable-Peg Model of Wholesale Rates.

to changes and demonstrations at will. The individual blocks may be considered as ordinates, and each one shows the primary rate and the secondary rate for a particular installation and load-factor. The height of the block indicates the total rate.

For instance, the rate sheet shows, for a maximum installation of 200 kw, with 33⅓ per cent load-factor, or eight hours' use daily, a net or total rate of 2.11 cents per kw-hour. Sticks of wood 0.5 in. by 0.5 in. in cross-section were prepared, and a length measuring 2.11 in. was cut off accurately, the scale being 1 in. = 1 cent. The secondary part of the rate, 1.21 cents, was also marked off on the block and that portion painted with shellac, so that the block or peg shows not only the total net rate, but also the relative proportion of the primary charge and the secondary charge. Each block or peg was prepared in this manner, the smaller pegs indicating in a striking manner the low rates earned under favoring conditions.

The blocks were placed in a frame, each block taking the same relative position as on the rate sheet. In all, about 800 blocks were used. Each block may be removed for inspection, as has been stated. It is considered that the model will be useful in studying any proposed changes in this rate schedule. When models are made in like manner for the company's other schedules a comparison will show any irregularities and at what points, for instance, customers are better off on the retail schedules than on wholesale schedules. Thus in the present model a group of high blocks, representing corresponding rates, is shown at the back. This would seem to indicate that customers having a small maximum and a low load-factor are better off on the retail schedule.

HANDLING THE CUSTOMER WITH A "KICK."

Handling customers with complaints is one of the most delicate and important duties of the central-station office staff. Wherever it is possible and the property is large enough a separate room should be set aside for adjusting disputes and "kicks," so that other patrons calling to contract for service or to pay bills will not be brought into touch with complaints about bills or service. Several Western companies equipped with such rooms report admirable results after thorough trial. These "complaint" rooms are arranged with suitable antechambers provided with comfortable chairs and reading tables, so that the waiting complainant may not be further annoyed by being forced to stand or walk about the main office. The advantages of such an arrangement are obvious and require no explanation to utility managers.

It is also essential, as pointed out by Mr. W. H. Hodge, of H. M. Byllesby & Company, that one or more office men be specially assigned to the receiving and preliminary handling of complaints. Such complaint or investigation men should be selected with great care and should be men of at least thirty years of age, married and with families. Only in rare instances does a younger or unmarried man or young woman possess the necessary experience with and insight into human nature to deal successfully with people who come to the office with grievances seemingly irreconcilable.

Many utility companies have found that telephone communications are among the greatest breeders of dissatisfaction on the part of the public. Individuals who are habitually polite in person often find it possible to be rude and uncivil when talking over the telephone. While every utility employee should be schooled in civility, it is very desirable that stated employees receive all telephone communications relating to trouble, disputes, grievances, etc. If for no other reason, familiarity with the work will assist materially in prompt and efficient disposition of the communications.

In handling disputes much depends on the manner in which the customer is addressed and the way the subject is presented or explained. The Commonwealth Edison Company, of Chicago, and other progressive organizations have insisted that no employees refer to the "rules of the company" as a reason why certain things are done by the company or certain things expected of patrons. Instead of talking about "the rules," employees are instructed to talk about the reasons behind the rules, giving the customer, so far as possible, a true understanding of conditions.

The advent into the office of a thoroughly angry man or woman who is absolutely sure that he or she has been unjustly treated by the company is often the one supreme occasion for converting such an antagonist into a friend. It is the time of all times to convince the complainant of the fairness of the organization and its entire willingness to take all the time necessary to go thoroughly over the grievance and to correct anything in which it has been at fault. The firmest kind of friends are made for utility companies in this way.

SECURING NEW CUSTOMERS BY GIVING ENERGY FREE FOR ONE YEAR.

Many central-station companies throughout the country offer special inducements in order to obtain new customers on existing lines. The majority of these take the form of wiring on deferred payment lines, but, so far as we know, no company in this country has adopted the plan successfully tried in Germany and Sweden of supplying the customer with free electricity for one year. The plan has many advantages, and its adoption does not entail the loss which the bald statement would imply.

Briefly stated, the scheme is based upon the following principle: To every customer who wires his house at his own expense free energy is supplied until the cost of the energy so supplied equals the cost of the wiring. The time of such free supply is, however, limited to one year, and the agreement is hedged about with certain conditions in order to safeguard the electric-light company against impostors. Among these conditions are the following: (1) That no installation in the rooms in question has previously been connected to the company's mains. (This is done to prevent old installations being replaced by new at the expense of the electric-light company.) (2) That the new installation must have its own meter. (This prevents unremunerative extensions to cellars, attics, etc., being made at the cost of the electric-light company.) (3) That the cost of the installation to which free energy is to be supplied does not exceed $4 per lamp, or $13.40 per motor. (This is to prevent large installations being connected in the free-energy scheme.) (4) That a revenue of at least $1.50 per lamp and $5.50 per motor for the full year be guaranteed to the electric-light company for each installation. (This insures that the actual cost of the free energy is covered.) These provisions apply only to lodgings, staircases, small shops and workshops and to other cases where in the opinion of the electric-light company they would be beneficial to the central station. (This prevents new buildings which must have electricity being supplied with free energy.) Such a system immediately becomes the property of the owner of the house, who is obliged to maintain it in good condition for at least five years and also to place it free of charge at the disposition of tenants. The service connections are made free of charge, and in the majority of cases the installations are made by wiring contractors and not by the electric-light company itself. The applicants make their own arrangements with contractors and in many cases pay the contractor in instalments. One company in Germany even goes so far as to pay the whole cost of wiring from the outset. The customer paying for this in monthly instalments is under the impression that he is paying only for the cost of the energy, and inasmuch as the cost of wiring is more than the normal cost of energy during one year, the consumer becomes accustomed to using a large amount of energy and continues to use electricity liberally after the period of free supply has passed.

As a means for loading up existing circuits the plan has worked well, and experience has shown that the small loss encountered in the first year is of no importance compared with the large gain in revenue the following years. One company increased the number of customers 31 per cent in a year, even in the slack times, and increased the number of connected lamps by 17.5 per cent, showing that the scheme appealed to small consumers who previously were kept away by the cost of installations.

ACTIVE LIGHTING CAMPAIGN AT WORCESTER, MASS.

A vigorous campaign to increase the lighting business has been under way at Worcester, Mass., since the early summer of 1911, the work being handled by the Worcester Electric Light Company along the lines of aggressive newspaper publicity, house wiring at moderate cost and flat rates for residence service based upon a charge of 1 cent per month per watt of connected load. The company opened the campaign on July 10 with a press announcement that residence lighting could be secured at a fixed price per month, and prices were published for the wiring of residences at reduced rates. Excess indicators are installed by the company in connection with the flat-rate contracts and

the 25-watt tungsten lamp designed for service on a 110-volt circuit has been adopted as the standard lighting unit. About 281 residence-lighting contracts have been secured, and the company has lately employed additional solicitors, who will specialize in this class of business.

The company's wiring proposition is given in the following table, which covers a complete installation in a four-room house:

Six outlets, inclosed wiring	$13.70
Parlor, two-lamp fixtures	2.50
Dining-room, two-lamp fixtures	2.50
Bedroom, one-lamp fixture, bracket type	1.25
Kitchen, one-lamp fixture	1.05
Porch lamp, switch inside doorway, dome shade	4.50
Cellar lamp, with switch upstairs	2.50
Eight 25-watt Mazda tungsten lamps	3.60
Total	$31.60

This equipment includes Brush brass fixtures and pressed-glass shades. The porch lamp is not counted in the enumeration of outlets. The company does no inside wiring itself, but turns the work over to the various local contractors with impartiality, giving the jobs out in small numbers in the order received. The arrangement has worked well, and in spite of a reduction in the price of gas to 80 cents per 1000 ft. the business is growing rapidly. On Jan. 1, 1912, the price of gas was reduced to 75 cents by the local gas company, which has one of the most economically managed plants in the United States, but the popularity of lighting residences by electricity is increasing by leaps and bounds.

The company furnishes electricity at the rate of 25 cents per 25-watt lamp per month, the bill thus being $1 for four regularly used connected outlets. The average number of watts connected per installation of flat-rate residence lighting is about 150. The company points out in its publicity matter that as many lamps as desired can be installed on the above basis; that a small home using four outlets can be lighted for a month at a cost of only 3⅓ cents per day; that hot, stuffy oil or gas lamps are avoided, with the elimination of sputtering and flickering lights, and that the consumer has the light where and when he wants it. A special point has been made of the health, safety, economy, adaptability and convenience of the service. A special folder issued by the company includes the following arguments:

"Frequently, on your way home at night, you will glance at residences along the street, admiring them. But what attracts your attention to these homes, especially on a dark night? It is invariably the 'cheerful atmosphere' of the homes, which, upon investigation, is found to be caused by the electric lighting used.

"Until recently the general public believed that electric light was only within the means of the so-called rich man, but, with the invention of the newer light sources and the adoption of the flat-rate method for charging, this company is making it possible for every resident in the city to use electric light.

"Experience has proved that the maximum number of lamps in use at any one time in the average six-room or eight-room house will range from four to six. The flat rate offered you by this company permits you to have as many lamps installed in your home as you wish, but you pay a flat-rate charge based only on the maximum number of lamps you may wish to use at any one time. For instance, you may have twenty lamps installed in your home, and if you decide on four lamps as the maximum number which you may wish to use at any one time, your lighting bill will be $1 per month. This means that your cost will be 3⅓ cents per day for four 20-cp Mazda or tungsten lamps burning at any one time. Can you burn four gas-lights continually for the same amount?

"Flat rate means a guarantee of your monthly light bill. There can be no question about the size or correctness of your lighting bill. You need not pay any attention to watching the use of your electric light just so long as you do not at any one time use more than the maximum contracted for.

"If your home is not wired this company offers to wire it for a sum which covers only the cost of labor and materials, plus a very small margin of profit to cover accounting. If you compare the special price now offered for wiring with the regular charge for this character of work you will find that you can save about 40 per cent. This special price is only possible because of the large number of houses to be wired as the result of this offer. The fixtures supplied are of brush brass and harmonize with the interior of your home."

The publicity campaign of the company has been carried forward in the local press, including a Swedish paper which reaches a large proportion of the population of that nationality in Worcester. Within five minutes after the office opened on the day in which the flat-rate service was first advertised telephone inquiries began to be received. Early in November the results indicated an average revenue per flat-rate installation of from $15 to $18 per year. The attitude of the public in regard to the use of the Excess indicator has been entirely favorable. The function of the device in flashing the lamps when the contract number is exceeded is quickly understood, and the company has had practically no objections to its use. There are now about 15,000 residences in Worcester, the population of the city being about 150,000. The total number of commercial and residence lighting customers on the company's circuits on June 30 last was 4500. Contracts for flat-rate house lighting are made for a term of one year on an index card requiring the customer to equip his premises with tungsten lamps only. The card sets forth the conditions of service in detail, explaining the fixity of the bill, the use of the indicator and other points. A deposit is required on these installations or a bond signed by the property owner.

In the industrial and mercantile lighting field the company has also been active of late. A special campaign was made before the holiday season, the company furnishing tungstolier fixtures equipped with four 100-watt lamps and also the 400-watt and 500-watt Mazda lamp with shade free of charge to meter customers contracting for a year or more of service. The company makes a charge for lamp renewals of only 50 cents per month on each fixture. This equipment means more than twice the illumination given two years ago for the same money. Early in the summer a new flat-rate window and sign lighting campaign was inaugurated, the rates varying from 65 cents per lamp per month with a 40-watt tungsten to $7 per lamp per month with the 500-watt unit. Sign lighting with 5-watt lamps is billed at 10 cents per lamp per month. These prices include the first installation of lamps and free renewals. All lamps burn nightly until mignight. Window lights are cut into service at sunset and sign lights thirty minutes later. The company has also reduced the selling prices of tungsten lamps from 35 cents to 25 cents in the case of the 5-watt lamp, with corresponding decreases, extending to a reduction of from $3.65 to a price of $3 for the 500-watt unit. The company's commercial-lighting revenue increased last year from $229,200 to $248,800, and the energy sales for illumination, exclusive of street lighting, increased from 4,555,000 to 6,558,000 kw-hours. The new turbine station in the south part of the city is now operating at excellent economy, and the outlook for the coming year in both lighting and motor fields indicates a much larger popularization of service in Worcester than has even before been contemplated. The company is now proceeding on the line of securing a large amount of business at a small profit instead of a small amount of business at a large profit, the latter policy having been followed in the earlier days of the organization, with the result that the community as a whole did not realize the value of the service. Mr. R. W. Rollins, formerly general manager of the Hartford (Conn.) Electric Light Company, is now general manager of the Worcester system.

Wiring and Illumination.

WIRING INSPECTORS MAKE GOOD USE OF MOTOR CYCLES.

Since the electric-wiring inspectors at Detroit have substituted motor cycles for horse-drawn runabouts their average number of inspections has increased from ten to eighteen and twenty a day. Detroit has a "wayside" telephone system in connection with the Home company's lines, and this facility is of great convenience in dispatching inspectors to new calls. The wayside system, as already mentioned in these columns, comprises connection jacks mounted on the company's poles in outlying sections of the city. Four jacks are arranged in series and make up a line ending in the usual subscriber's equipment at the exchange. The talking sets are rented by the telephone company, with the privilege of connection to any wayside jack, from which any city telephone can be called. Nearly 500 such jacks are now installed in Detroit, enabling inspectors to make hourly reports to headquarters.

PROTECTION OF BUILDINGS FROM LIGHTNING

Practical suggestions on the protection of buildings from lightning strokes were given by Mr. H. B. Long, Nashville, Tenn., before the convention of the Western Electrical Inspectors at Milwaukee, Jan. 24. Stranded or other conductor with large surface is preferable, he said, on account of the skin effect of the lightning discharges. Except for durability, iron or copper is equally satisfactory. A good conductor is made from ¾-in. galvanized-iron pipe. The conducting network should rise several feet above the highest points of the building protected, and should thoroughly encircle it, being grounded to the wall at intervals of 20 ft. or less. Down-spouts and gutters should also be bonded to the lightning conductor. Good ground connection must be provided by attaching to water pipes or ground rods. The ground rod or pipe must be driven to permanent moisture, and preferably surrounded by a bed of coke to attract and hold moisture.

POINTS FOR THE ELECTRICAL CONTRACTOR TO CONSIDER.

In discussing the problems of the electrical contractor before the Illinois Electrical Contractors' Association at Chicago, Feb. 3, Mr. L. B. Van Nuys, Peoria, urged the compilation of careful estimates of cost for each job figured on, without respect to the prices given or declared to have been given by other contractors. "Have the nerve to figure your own work and stick to the prices you offer," advised Mr. Van Nuys, who is a practical contractor. "Refuse to accept the supposed estimates of other firms which the customer may attempt to quote in trying to reduce your price. In one city recently a number of contractors got together to compare notes on work taken under supposed competitive conditions and found that not three-fourths of the jobs had really been bid upon competitively. The customers had simply relied upon the credulity of the contractors to beat down their original prices, and each man, supposing that he could do work as cheaply as the next one, though wondering, had accepted contracts at what was really bare cost." Mr. Van Nuys also offered a warning to the small contractor against the lure of buying in "standard packages" at the risk of overstocking. Instead, he urged the small man to confine purchases to immediate needs, paying the higher broken-package price, if necessary, but securing the discount for cash. This usually amounts to 2 per cent, and by restocking often on a cash basis the dealer can earn as much as 12 per cent a year, which is much more than he would save by buying standard packages whose contents, as dead stock, might linger on hand for a year.

PROGRESSIVE INSTALLATION OF UNDERGROUND SYSTEM.

At Newark, Paterson and other places in New Jersey the city requires that each year one mile of lines of the electric-light company shall be placed underground; half of this to be selected by the city, presumably in congested locations, and the other half by the company, as desired. This means, of course, that all of that company's wires on this particular mile must be placed underground in ducts. A relatively similar plan is to be followed in respect to electric lines other than those of light and power companies. The companies own their own ducts, but the State of New Jersey is working for state control of underground systems of electrical operating companies. The cost of placing this mile of wire underground in each of the two locations given is about $50,000 per year for each electric light and power company.

A COST SYSTEM FOR CONTRACTORS.

A method of recording the costs of jobs already completed in order to secure data for figuring future work was outlined by Mr. C. G. Rush, Chicago, before the Illinois Electrical Contractors' Association, Feb. 3. Mr. Rush preserves his data in the form of a card catalogue, preparing a line of unit costs for all operations of wiring work. For example, on open wiring $12 a thousand is charged for mill work, 15 cents for spotting outlets, 12 cents each for making up drop cords, etc. Similarly, exposed conduit is charged for at the rate of $6 a thousand and unit prices are recorded for such operations as pulling in wire, installing boxes, etc. Using this system, Mr. Rush testified that he has never fallen short in making estimates where he could give his personal attention to the work. The attempt to get office employees or others to carry out such a cost system does not always result so satisfactorily, however, and unless care is taken the consequence may be an "even break" instead of a profit. To accentuate the individuality of the contractor, Mr. Rush advised each firm, even the smaller ones, to use its own order-blank head, with name, address, etc., when purchasing supplies. The impression thereby created with the jobber is beneficial to the contractor's credit. In dealing with customers the contractor should pay some attention to his own personal appearance, although the chief requirement is that he create the impression of being a man able to "put through the job." The man who goes out to get business must be equipped with all the information the customer may require, ready to tell on the spot everything that may be asked of him.

TUNGSTEN STREET LIGHTING AT JOLIET, ILL.

The Public Service Company of Northern Illinois has placed in service at Joliet, Ill., an ornamental tungsten street-lighting scheme in the business section of the city, a view of one of the streets at night being shown herewith. To make room for the installation all of the electric-light poles were removed from the business section of the city and the wires placed underground. The lighting company in conjunction with the railway company then set new trolley poles in concrete so as to assure a perfectly straight line of poles. The latter are spaced 70 ft. apart, and 14 ft. above the sidewalk are fixtures holding four 60-watt mul-

tiple tungsten lamps. Thus far twelve blocks have been equipped, the work being intrusted to the Morris Iron Company, Frederick, Md.

For a time there existed in the minds of central-station men doubts as to the merits of trolley-pole systems, it

Street at Night in the Business Section of Joliet, Ill.

being felt that the fragile multiple tungsten lamp would show undue maintenance costs owing to the vibration present. Trolley-pole systems at present in existence, however, do not bear out these fears and possess in addition the advantage that they do not add to the obstructions already on the sidewalks, and in installations such as that at Joliet the obstructions are actually lessened by utilizing existing trolley poles and doing away with the electric-light poles.

THE CHOICE OF REFLECTOR.

Much interest was manifested in the presentation and discussion of a paper entitled "The Choice of Reflector: Its Influence Upon Illumination Efficiency and Depression in Visual Function," by Messrs. Arthur J. Sweet and L. C. Doane, before the New York Section of the Illuminating Engineering Society on Feb. 8. The authors described a long series of investigations relating to the performance of commercial types of reflectors, including prismatic, opal, metal, globe indirect and semi-indirect units.

In determining the so-called illumination efficiency of the various reflectors a comparison was made between the lumens effective on the horizontal plane of reference and the lumens produced by the bare lamps without reflectors. The tests were conducted in an office room 13.5 ft. wide, 23.5 ft. long and 10.3 ft. high, the walls being covered with either white mat cardboard or black canton flannel. The reflection coefficient of the former was 73 per cent and of the latter 2.3 per cent.

Two general types of illuminating installations were investigated, namely, the distributed-unit type with five 40-watt lamps producing a total of 1914 lumens and the "center-of-room" type with one 150-watt and one 100-watt lamp producing a total of 2075 lumens.

An indication of the results of the tests is given in the accompanying table, which shows the relative illumination efficiencies of the various reflectors when used according to the distributed unit and the center-of-room arrangements with light and with dark ceilings and walls.

Depression in visual function, so called, was determined by means of a testing equipment specially built for the purpose. A comparison was made between the intensity of illumination which just permitted an observer to determine the shape of a certain test object when no other object was illuminated within the range of vision and the intensity of illumination required on the same object when the observer's eye was affected by the illuminated walls of the room. The ratio between these two was called the "visual efficiency" of the lighting equipment employed in the room. The highest value of this so-called "efficiency" was 100 per cent, obtained with the prismatic focusing reflector and dark walls, while the lowest value was 53, obtained with the same reflector and light walls.

As a result of their investigations the authors concluded that from the standpoint of illumination efficiency the correct type of prismatic reflector is considerably more satisfactory than any other type of lighting unit. If the correct type of prismatic reflector is not chosen, the results are about equal to those given by other types of reflectors. Light density opal glass is not a suitable material for reflectors, except, possibly, for types of service where esthetic considerations strongly outweigh considerations of illumination efficiency, and where, at the same time, the taste of the light user is such as to lead him to prefer the esthetic effect given by a light density opal reflector. There is a considerable variation of taste on this point. Light density opal reflectors should never be used in illuminating interiors having walls of a high coefficient of reflection where long-continued, close visual work is frequently performed. Dark walls exercise much less influence in cutting down the efficiency of illumination than has been previously supposed. Where wall reflection coefficients are low, relative depression in visual function affords no highly inportant reason for choosing one type of reflector over another. On the whole, however, if long-continued, close visual work is to be performed under the lighting installation, it will be

Type of Reflector.	DISTRIBUTED UNIT.		CENTER OF ROOM.	
	Light.	Dark.	Light.	Dark.
Prismatic, focusing	58.5	42.5	.....	.....
Prismatic, intensive	53.0	34.5	61.0	44.0
Prismatic, focusing, satin finish	51.0	32.5	.....	.....
Aluminumized metal, intensive	46.5	39.5	.....	.....
Aluminumized metal, extensive	.....	.....	50.0	44.5
Prismatic, intensive, satin finish	48.5	29.5	55.0	36.0
Medium density, opal, high glaze	46.5	31.5	54.0	38.0
Prismatic, extensive	.....	.....	52.0	37.5
Heavy density, opal, depolished	44.0	30.5	51.0	39.5
Light density, opal	46.0	26.0	52.0	35.0
Prismatic, extensive, satin finish	.....	.....	48.0	31.5
Bare lamps	42.0	15.5	43.0	18.0
Indirect, mirror reflector	.....	.....	36.0	7.5
Semi-indirect (8% and 92%)	.....	.....	29.0	9.0

wiser to choose the type of unit giving minimum depression in visual function, even when wall reflection coefficients are low. If the wall reflection coefficients are of high value, it is of very considerable importance to select units giving minimum depression in visual function, especially for service where long-continued, close work is to be performed. The relative influence of different types of lighting unit in causing depression in visual function may correctly be judged by the relative light flux within, approximately, the angles of 50 deg. with the vertical and 80 deg. with the vertical. The flux emitted by the light unit in the 60-deg. to 70-deg zone is especially fruitful in causing depression in visual function. In this connection it should be noted that in the case of indirect lighting the distribution curve of the reflected light from the ceiling should be taken as the distribution curve of the light unit. In the case of semi-indirect lighting the net curve of the ceiling reflection and of the direct light from the unit should be taken as the distribution curve of the unit. Walls up to the height normally coming within the field of vision should have as low coefficients of reflection as is consistent with the avoidance of gloomy and depressing effects. In this connection it will be noted that the loss in illumination efficiency incident to the use of dark walls is fully compensated for by the gain in visual efficiency.

Discussion.

Mr. E. L. Elliott claimed that the glassware known to the trade as "alba" cannot properly be designated as opal, because it possesses illumination properties not found in opal glassware. In defining illumination effects distinction must be made between light diffusion and distribution. Even when the light is well distributed the diffusion may be poor. Good diffusion means a large number of widely separated sources of light.

Mr. P. S. Millar called attention to the valuable work of investigation which had been rendered possible by the facilities afforded by the laboratories and trained investigators maintained by an industrial company and now given forth freely to the Illuminating Engineering Society. He stated that opal glass reflectors can be used quite as effectively as can the different types of prismatic reflectors. He remarked that, measurements made on the "depression of visual function" at low illumination intensities must not be assumed to represent the conditions at high intensities.

Dr. Herbert E. Ives said that the ability to distinguish difference in illumination intensities is a function of the ratio of the two intensities rather than of the arithmetical difference, and hence the actual difference varies directly with the intensities and is not constant, as the authors have assumed.

Mr. Norman Macbeth agreed that the method employed in determining the illumination efficiency is incorrect because 100 per cent efficiency would mean exclusive illumination of the floor with the walls and ceiling in total darkness. Such a result would be highly unsatisfactory.

Mr. S. W. Ashe described a form of test object which has proved thoroughly satisfactory in visual acuity investigation. It consists of small black wires stretched in parallel positions in front of a white background. The wires are separated by a distance equal to the wire diameter and are held in place by being mounted along the threads of a screw cut for this special purpose.

Mr. S. L. E. Rose said that the authors were not justified in assuming that the prismatic type of reflector is more satisfactory than any other type of lighting unit, as other types give equally good results.

Mr. R. F. Pierce stated that the indirect system of lighting when properly designed and installed is much more satisfactory than the author's conclusions might lead one to believe.

In closing the discussion, Mr. Sweet argued that, ignoring color effects, the various styles of reflecting glassware included under the head of "opal" differ merely with reference to the percentage of reflection and absorption. The air of mystery that the advocates of certain reflectors place around their glassware would be dispelled by the presentation of the actual scientific facts upon which their claims are based. One type of glassware may be more artistic or possess a better color than another, but in illumination efficiency the types differ only in reflection and absorption.

RECENT TELEPHONE PATENTS.

REPEATER SYSTEM.

In most attempts to adapt the telephone repeater to practice it has been accepted as essential that the repeater station shall operate automatically in both directions. Much work has therefore been done to devise two-way repeaters or two-way repeating circuits. Not long since, however, a repeater system was devised which abandoned this two-way idea and introduced control apparatus which should automatically change the connections of the line to the repeater in accordance with the direction from which the exciting voice currents were received.

The present patent, granted to Mr. C. Adams-Randall, of New York City, and assigned by him to the Randall Telephone Manufacturing Company, recedes still further from the automatic two-way plan, as here the control switches which determine the direction of repetition operate in response to a manual push-button at the telephone station. Each party keeps his button pressed while speaking.

COMMON-BATTERY SYSTEM.

To Mr. W. W. Dean a patent has been granted for a circuit system for a common-battery two-wire system. The line battery is fed through a high-resistance line relay permanently connected to the line on the one side and a low-resistance retardation coil upon the other side. The cord-circuit battery is fed on the one side through a low-wound supervisory relay which connects to the same pole of the battery as the line relay and whose back contact is included in the supervisory lamp circuit, and through a high-resistance relay is connected to the same pole of the battery, of which the front contact is included in the supervisory lamp circuit. In operation the low-wound supervisory relay shunts out the line relay, the circuit of both being controlled by the subscriber's hook switch. The circuit of the high-wound supervisory is dependent solely upon the connection of the cord circuit to the line jack. Another feature of this circuit lies in the fact that the initiation of a call at the substation causes the busy test to appear upon the jack sleeve before the operator has plugged. This patent is assigned to the Kellogg Switchboard & Supply Company.

COMBINED TRANSMITTER AND RECEIVER.

Mr. W. B. Thompson, of North Conway, N. H., has invented a combined transmitter and receiver in which these two distinct elements are included in a common cylindrical casing. At the rear of the casing a bridge is mounted which carries the microphone button, with a long spindle extending almost to the front of the casing. A heavy diaphragm with a central perforation to clear the transmitter spindle is then mounted forward of the button. This diaphragm carries the receiver magnets. The perforated receiver diaphragm is mounted facing the magnets, while in front of all, surmounting the spindle, is a small diameter transmitter diaphragm guyed four ways to the walls. The mouthpiece is carried upon a face plate which closes the cylinder. This arrangement of the parts is, of course, made possible by perforating the receiver so that the spindle of the transmitter may pass through it without contact.

PARTY-LINE SYSTEM.

A step-by-step party-line system forms the subject of a

patent granted to Mr. A. Marchand, of Bridgeport, Wash. The impulses are furnished by a hand generator the crank of which carries a controlling cam. The system includes a lock-out feature and further an alarm which indicates when the line is being left off normal. This alarm, a buzzer, sounds with the return of the receiver to the hook until the line has been cleared by proper manipulation.

TELEPHONE ACCESSORIES.

To prevent outside disturbances from interfering with conversation, a telephone hood has been designed and patented by Mr. G. W. Lancaster, of Richmond, Va. The hood is a rectangular boxlike affair with one corner of the rectangle cut away and the edges so shafted as to fit the neck and shoulders of the telephone user when his head is in the box. Within the box the telephone set is mounted upon a shelf, the hook switch lever being extended through the wall and the receiver being replaced by twin watch-case receivers upon a flexible support.

Mr. G. L. Bennett, of New York City, is the inventor of an adjustable receiver support for holding a hand receiver at the ear of the user. The supporting arm is carried upon a bracket and may swing in a vertical plane. A linkage serves to depress and raise the switch lever. The arm is held in position by a toggle spring or a sliding counterweight, either of which will hold it in the position in which it was last placed.

Letters to the Editor.

ANALYSIS OF RUBBER COMPOUNDS.

To the Editor of Electrical World:

SIR:—Mr. W. Jones' letter on the "Analysis of Rubber Compounds," on page 320 of your issue of Feb. 10, is quite interesting, but there are a few points to which exceptions may be taken.

First, it should be recognized that there is no theoretical way of determining the usefulness of a rubber compound merely from its chemical composition. The only purpose that can be served by a chemical analysis is the identification of a compound or type of compound that has proved its worth in practice. It is, therefore, almost immaterial whether analysis shows a compound to have the same composition as the standard or whether the same ingredients can be got out of it as from the standard. Exception is, therefore, taken to Mr. Jones' statement that it is important to know what is in the compound, the real desideratum being a means of identifying the compound with others which have given good practical service.

Second, many chemists will disagree with Mr. Jones' statement that "all the oils and resins in an extract from rubber are quite easily saponified." Do not recent researches show that Para rubbers contain considerable unsaponifiable resin?

Third, Mr. Jones presents interesting evidence to show that vulcanization does not increase the extract in rubber compounds. Is it not the mastication previous to squirting it on to the wire which causes the increase noted by so many chemists? It is well known that insulation made by the strip process yields less extract than that which is squirted through dies; and it is the writer's opinion that this is due to the necessity of mashing the compound to a semi-fluid state in order to make it pass through the dies.

An ideal specification for rubber insulation, if it specifies chemical composition, should also specify the procedure of analysis. If this is not done the manufacturer has to take a big chance of having his material rejected, and consequently adds an item for risk to his price. For the same reason any proprietary method of analysis which is kept secret by a chemist is likely to be a cause of endless trouble to manufacturer and public alike, as there is no way for either party to disprove a statement by the other that the chemist is in error.

Acting under this conviction, a group of representative consumers and manufacturers of rubber insulation have appointed a committee on rubber analysis, as described in your issue of Dec. 16, 1911. This committee, of which the writer is secretary, is prepared to receive and give due consideration to any method of rubber analysis, direct or indirect, proposed to it, and will publish the results.

New York. WM. A. DELMAR.

ELECTRICAL THEORY OF GRAVITATION.

To the Editor of Electrical World:

SIR:—It was with interest that I studied Dr. Crehore's paper on "An Analysis of the Causes of Gravitation," and I wish to express my appreciation of such a scholarly attempt to bring yet another phenomenon into the domain of electromagnetic theory.

It may seem premature to criticise Dr. Crehore's paper before his entire theory appears in a completed form, especially in the case of a physicist of such high standing. There are, however, several assumptions upon which the whole theory proceeds which it seems to me are by no means clear. I shall briefly enumerate them, in the spirit of inquiry rather than controversy.

The fundamental assumption of the theory is that "the value of the magnetic force at any point near a moving charge is given by

$$H = \frac{\mu e q (1 - \beta^2)}{r^2 (1 - \beta^2 \sin^2 \theta)^{\frac{3}{2}}} \sin \theta,$$

the meaning of the various symbols being given in Dr. Crehore's paper. If I am not mistaken, this solution was first given by Oliver Heaviside, and holds only for a charge moving in a straight line with uniform velocity. This assumption is fundamental to the mathematical solution and greatly simplifies the mathematical work. I have not been able to find or work out a complete solution for a charge moving in a circular orbit, but from the form of the differential equations it is very certain that the solution given above will not apply. Dr. Crehore assumes that the solution holds for circular motion and proceeds to calculate the value of the electromotive force or electric intensity on this assumption. I cannot believe that the method of calculation is correct—an inference which is supported by the fact that his value of the electric intensity is not that given by Heaviside's solution, where it is shown that the electric intensity is radial and everywhere of the same sign as the moving charge, instead of being alternating.

A second point is that Dr. Crehore's theory takes into account only the electric force due to the moving corpuscles, and disregards the electric field of the fixed central charge of opposite sign, which must exist if the atom is electrically neutral.

Thirdly, there would seem to be no basis for the assumption that a charged corpuscle moving through an electric field is acted upon differently from what it would be if the corpuscle were at rest. It is true that its own electric and magnetic field is a function of its motion, but there is no reason to suppose that the action of an external electric field on it is changed by its motion. The action of an external electric field on the moving corpuscle is the same as on a stationary charge of equal value, while the action of an external magnetic field is the same as the action on a current element of equal value.

I am only too well aware that the above considerations are very sketchily stated rather than developed, for which my excuse must be lack of space in a communication of this kind. They do, however, in my opinion, constitute serious objections to Dr. Crehore's theory in its present form,

Pittsburgh, Pa. JOHN R. CARSON.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Overload Range of Three-Phase Induction Motors.—M. Vidmar.—A mathematical article giving a simple and practically accurate formula for calculating the overload U (ratio of the maximum output for a given voltage and frequency to the normal rating). It is

$$U = \frac{E\sqrt{3}}{736\,\text{hp}}\left(\frac{i_k}{\sin\theta_k} - i_m\right)\frac{1-\cos\theta_k}{2\sin\theta_k}$$

where E is the voltage, hp the normal rating of the motor in horse-power, i_k the short-circuit current, i_m the no-load current and $\cos\theta_k$ the power-factor at short circuit. This formula is far more exact than the recent formula of Auerbach for the same purpose. Besides the maximum load which a motor can carry, its maximum torque is also of importance. The maximum torque in kilogram-meters is

$$\frac{E\sqrt{3}\,p}{9.81\times 2\pi n}\left(\frac{i_k}{\sin\theta_k} - i_m\right)\tfrac{1}{2}\,\text{tg}\,\frac{\gamma}{2}$$

where p is the number of pairs of poles of the motor, n the frequency and $\text{tg}\,\gamma = 2\,\text{tg}\,\theta_k$. Both formulas give exact results for all purposes of practice. Their application is illustrated by numerical examples.—*Elek. u. Masch.* (Vienna), Jan. 28.

Heat Paths in Electrical Machinery.—An account of the discussion which followed the paper by Symons and Walker recently abstracted in the *Digest*. A. H. Law pointed out the relatively small difference in the thermal conductivity of various insulating materials. He referred to the experiments of the authors demonstrating that although the heat conductivity along the laminations was 100 times as great as across the laminations, the influence of this on the maximum temperature rise was small. This was most interesting, since in the most usual designs the heat had to be conveyed across the laminations. The alternative was, of course, to carry the air through longitudinal ducts in the core, but that meant that the ventilating air was never compelled to pass over the surface of the rotor or stator coils, and that therefore the stator coils could be cooled only by conduction through the iron. It seemed to him a great advantage to pass the cold air first through the rotor windings—whose current-carrying capacity limited the whole output of the alternator—and next through the high-tension windings, and finally over the surface of the iron, whose temperature was relatively of much less importance. E. H. Rayner emphasized the ineffectiveness of air for cooling on account of the large quantities of air required. If instead of air one could use water for cooling, about 35 liters would have the same cooling effect as 120,000 liters of air, so that if it were possible to cool the stator only by means of water the volume of liquid would be only 0.03 per cent of the volume at present required. Other speakers in discussion replied that customers do not want water-cooled machines even though they have been offered in the market. T. J. Sack said that the thermal conductivity of insulating materials is almost proportional to their disruptive strength. In America Empire cloth is being used for cable insulation, one of the points urged for it being that such a cable is better able to withstand an overload. He believes its high heat conductivity accounts for that result. In his reply M. Walker agreed that the efficiencies of fans on shafts are not as great as could be desired, and they are sometimes as low as 20 per cent. He said that a much higher efficiency can be obtained by having a specially designed fan and blowing machine for large alternators. It is worth while to do that, but as a rule it is a question of cost. In the discussion at Manchester E. W. Marchant referred to the temperature rise of a coil supplied with a constant amount of power, the heat loss being assumed to be proportional to the temperature rise, according to the formula $\theta = \theta_f\,(1 - e - t/T)$, where θ is the temperature rise at time T, θ_f the final temperature rise, and T the quantity usually called the heating-time-constant, which depends upon the mass and specific heat of the coil and upon the radiating surface. The value of T may be found approximately for a transformer or other similar machine by observing the rate of decrease of temperature of the coils per degree of temperature rise. The heating-time-constant is the reciprocal of this quantity. In order to estimate T the transformer might be run for a short time, the former supply to it shut off, but all cooling arrangements left working, and the rate of decrease of temperature observed. The estimate is, of course, approximate, but serves to show how long a heat run should be continued. Theoretically the temperature rise at the end of a time equal to the heating time constant would be 63.6 per cent of the final rise. At the end of a time three times as great as the heating-time-constant the temperature rise would be 95 per cent of the final rise, and this time for heat run is ample for all practical purposes. With respect to the same point C. Smith said that the law of temperature rise often departs greatly from the simple form given above, owing to the complex nature of a machine when considered as a heating body. He claimed that the law of rise of surface temperature of an armature must be regarded as the summation of the law for the several parts in which energy is being lost; that is, for an armature the copper, the teeth and the core each have their own heating-time-constant, and should there be, as is often the case, any great difference in the respective constant the summation would give a law which is not simple.—London *Electrician*, Feb. 2.

Single-Phase Commutator Motors.—R. E. Hellmund and E. W. P. Smith.—While the fundamental principle of operation of the single-phase series motor is the same as that of direct-current series motor, there are essential differences in design and construction, as is shown by close comparison of the two types. These essential differences are the laminated core of the alternating-current motor, the comparatively large number of poles of the alternating-current motor, the use of a distributed auxiliary winding on the alternating-current motor in addition to the main field winding, the larger armature diameter as compared with that of a direct-current armature, the short and stubby poles made possible by the small number of field ampere-turns on the alternating-current motor, the large and wide commutator of the alternating-current motor, the larger number of segments as compared with direct-current machines, and the small air-gap.—*Elec. Journal*, February.

Mercury Arc Rectifier.—Q. A. Brackett.—An illustrated account of the operation of mercury-arc rectifiers in practice, especially for the purpose of battery charging.—*Elec. Journal*, February.

Lamps and Lighting.

Miners' Lamp and Firedamp Detector.—Holmes-Anderson has devised electric miners' lamps which indicate the presence of firedamp in the atmosphere by a reduction of the light given out. For this purpose the filament of the incandescent lamp is in series with a special platinum wire resistor. Platinum in a firedamp atmosphere acts as a catalytic agent, causing combustion of the gas with oxygen, with a resulting increase of the temperature and increase of the electrical resistance of the platinum wire. The current therefore decreases, the lamp darkens, and the

miner knows that there is danger. Fig. 1 shows an instrument for measuring the amount of firedamp in the atmosphere, in combination with the miners' lamp *L*. The current is supplied by the battery *D*. The two resistor wires *A* and *B* have the same resistance at ordinary temperature. One, *A*, is made of a metal which is not affected by firedamp; the other, *B*, is made of platinum, and is therefore affected by the presence of firedamp. As long as there is

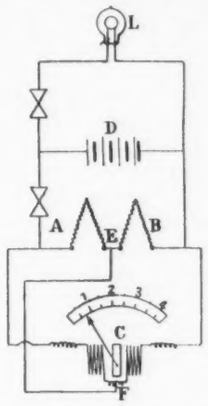
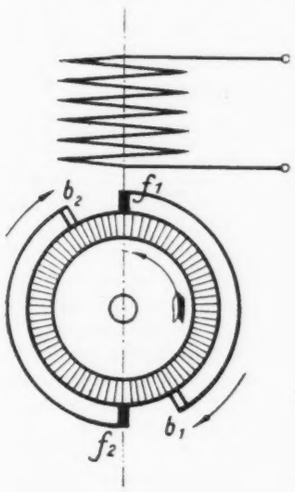


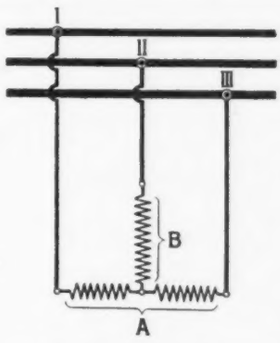
Fig. 1—Firedamp Detector.

no firedamp in the atmosphere the two halves of the system shown in the illustration are in balance and the differential voltmeter *C* gives no deflection. The presence of firedamp causes the resistance of *B* to vary, and the deflection of the differential voltmeter *C* gives a direct indication of the proportions of firedamp present in the atmosphere. It is thus possible to detect the presence of 0.25 per cent of firedamp in the atmosphere.—*Le Génie Civil*, Jan. 27.

Generation, Transmission and Distribution.

Three-Phase Winding Plant.—An illustrated description of a three-phase winding installation made by Brown, Boveri & Company in a Continental European mine. The machine itself is a special form of the Deri single-phase repulsion motor and is shown in Fig. 2. It consists of two single-phase motors combined to form one machine, the





FIELD CONNECTIONS OF DOUBLE MOTOR.

Fig. 2—Diagrams of Deri Motor Connections.

stator windings being so connected as to allow of the motor being connected up to a three-phase circuit with an equal distribution of load on the phases. The two halves of the rotor, although mounted on a common shaft, are quite independent of each other electrically, and each half of the rotor is provided with a commutator. As in the case of the single-phase Deri motor, each commutator is provided with two sets of brushes, one fixed and the other movable, and these are electrically connected. The movable brushes of both commutators are coupled together mechanically and are operated by means of connecting rods directly from the control pedestal. The whole control of the motor, starting, stopping, reversing and electrical braking, is effected by the movement of the movable brushes on the commutators. When the motor is at rest the movable brushes are by the side of the fixed brushes along the center line of the poles, and even when the main switch is closed the motor will not tend to rotate, since no current passes through the rotor. As soon as the brushes are displaced from their neutral position in one or the other direction there is produced a torque tending to turn the rotor in the opposite direction from that in which the brushes are displaced. The torque exerted by the motor and its speed are dependent upon the angle through which the movable brushes are displaced, and for every position of the brushes the motor has practically a series characteristic; that is, the greatest torque is exerted at the lowest speed. These motors can exert a high starting torque with a comparatively low current consumption. If the brushes are brought back through their neutral position and displaced in the direction in which the motor is rotating, the motor acts as a generator and regenerative braking is obtained, the degree of which varies in the same way with the brush displacement, the braking action not being limited to any particular speed of the motor. No starting or regulating resistors whatever are required. The winding speed is dependent upon the torque required, so that the lighter the load the higher may the speed be raised. Moreover, if it is necessary to "force" the plant, this can be done by accelerating with the greatest possible torque until retardation is necessary. Some details are given of the braking arrangements, and it is claimed that the system is more efficient than the Ward-Leonard direct-current system. Up to the present time three-phase motors of this type have not been designed for higher ratings than about 750 hp, and the above system is recommended only for medium installations.—Lond. *Elec. Engin'ing*, Feb. 1.

Electric Gear.—MAX BRESLAUER.—An illustrated description of the new gear, based on the principle of unipolar induction, illustrated and described on page 191 of the *Electrical World* dated Jan. 27, 1912. It represents an electric-power transmission over minimum distance, both the motor and generator being of unipolar design. The two machines are independent of each other, but are placed side by side so as to form a unit. The electric connection between casing and armature as well as between the two armatures is accomplished by means of mercury. The emf is generated in the two inner flanges of the rotating armatures, the conductor being the active iron itself. This is permissible because in this case no series connection is required as is usual with unipolar machines, because the relatively small voltage produced in a single conductor is sufficient to yield a good efficiency on account of the very low resistance of the "power-transmission line." When this unipolar gearing is used as an ordinary coupling the primary and the secondary excitations are equal. With equal numbers of r.p.m. a secondary counter emf is produced which, aside from the voltage drop, is equal and opposite to the primarily generated emf. When the excitations are different—for instance, the secondary twice that of the primary—a transmission ratio of one to two is obtained, and by varying the excitations the ratio of transmission can be adjusted at will. This unipolar gearing, therefore, represents a complete Ward-Leonard system, that is, a generator which acts with variable voltage on a motor the speed of which can be further adjusted by variation of its own excitation. One of the advantages of this unipolar gearing is its small weight. For a gearing of 60 hp with primary and secondary speeds equal to 1800 r.p.m. and with an efficiency of 94 per cent the weight is 115 kilograms (253 lb.). The theory of the gearing is given. For a certain design the efficiency and weight are calculated.—*Elek. Zeit.*, Feb. 1.

The first part of an English translation of this article appears in the London *Electrician*, Feb. 2, and the first part of a French translation in *La Lumière Elec.*, Feb. 3.

Speed Regulation of Three-Phase Motors.—G. Meyer.—An English translation of his paper recently abstracted in the *Digest* on economical methods of speed regulation of three-phase motors. The author discusses the various means of varying the speed of three-phase motors without loss and describes the several uses to which they can be put. According to the amount of speed regulation required and the size of the unit in question different methods are applicable. For outputs up to 500 hp and any desired range of speed the series commutator motor or the double repulsion motor can generally be used. The field of application of the shunt commutator motor is more restricted. For larger outputs, where only a limited speed range is necessary, variable-speed sets are available. These usually consist of an induction motor as the main motor and a commutator machine as the part of the auxiliary set for producing the regulation. When complete speed regulation of very large outputs is in question it is advisable to adopt the Ward-Leonard continuous-current system.—London *Electrician*, Feb. 2.

Steam Turbines.—K. Baumann.—A paper read before the Manchester section of the (British) Institution of Electrical Engineers on recent developments in steam-turbine practice. After outlining the development of the various types of steam turbines, the author compares modern turbines as regards economy and first cost. He then discusses the maximum output obtainable from the drum and the disk types, the critical speed of turbine rotors and the increase of the field of application of turbines. After tabulating the best results as regards steam economy obtained in recent years, he gives curves and figures showing the effect on the steam consumption of changes in superheat, vacuum, pressure, etc.—London *Electrician*, Feb. 2.

Diamond Mines of South Africa.—A van der Ham.—An illustrated description of the electric installations of the De Beers Consolidated Mines in Kimberley and of the Premier Diamant Mine in the Transvaal. While electricity is used for lighting, traction and certain motor purposes, steam is still the principal source of power in these mines.—*Elek. Zeit.*, Feb. 1.

Oil Engine Plant.—The central station at Kingston-on-Thames in England will install two new horizontal Diesel engines of 250 kw to 300 kw rating, driving alternators.—London *Elec. Review*, Feb. 2.

Traction.

Single-Phase Traction.—W. Kummer.—A paper in which the author first briefly discusses the different designs of single-phase traction motors and their behavior while hauling and during braking. The relation between normal torque and active volume of the motor is used as the basis for projects of the motor equipment of locomotives and motor cars. A figure of comparison between different single-phase traction systems is suggested, being essentially the ratio of torque of the car to weight of the car.—*Elek. Zeit.*; Feb. 1.

Installations, Systems and Appliances.

Electricity Supply in London and New York.—M. Tappley.—An article giving comparative statistical data on electricity supply in London and New York in 1910. A number of tables giving data on street lighting bring out the higher standard attained in New York. The number of arc lamps employed in New York is more than twice the number reported as in use in London, and, though the actual number of incandescent lamps is higher in the latter case, the proportional development, taking into account the greater area and population served, is considerably lower. The most striking feature of the London data, considered alone, is the enormous extent to which metallic-filament lamps are now employed in street lighting. In the larger thoroughfares the predominance of the flame arc over the other types is being rapidly asserted. On the other hand, tables on the cost of energy supply and maintenance show that the annual costs in New York are from 60 per cent to 100 per cent higher than in London; the average candle-power per lamp is somewhat higher in New York, as also are the burning hours, but these factors alone do not account for the wide discrepancy between the two sets of figures. In ten of the inner and three of the suburban London areas considered, street lighting is charged by meter, the price ranging from 2 cents to 3.8 cents per kw-hour in the borough, and from 5 cents to 6 cents per kw-hour in the suburban areas. The corresponding averages are 2.92 cents per kw-hour and 5.6 cents per kw-hour; that is, 34.4 per cent and 66 per cent of the average rates for private lighting, in the respective groups of undertakings. Direct-current supply is available in 72 per cent of the "town" and 80 per cent of the "suburban" supply areas in London, while alternating current is provided (alone or in addition to direct current) in 56 per cent of the town and 47 per cent of the suburban areas.—London *Elec. Review*, Feb. 2.

Power-Factor Correction.—N. Stahl.—For the purpose of power-factor correction synchronous motors may be used to supply the corrective current, either leading or lagging. While rotary converters possess the characteristics of a synchronous motor the use of rotary converters for power-factor correction is dangerous. The reasons for this are discussed in some detail, and it is shown that dangerous heating results in certain coils when the machine is operated at normal load or overload, at power-factor other than unity.—*Elec. Journal*, February.

Tariff.—Carl Schmidt.—In continuation of his serial on various problems of energy distribution from central stations, the author endeavors to utilize the results obtained in his former articles for the purpose of devising a uniform tariff. He calculates the cost to the central station of supplying energy to different groups of consumers and recommends a tariff based on fundamental prices for the kilowatt-hour charged to these different groups of consumers according to the calculated cost. The fundamental difference between the different groups is the time during which they use energy. The author concludes with an account of the damage which has been done by the introduction of wrong methods of charging.—*Elek. Zeit.*, Feb. 1.

Wires, Wiring and Conduits.

Joints of Conductors.—Carl Egner.—An illustrated description of a simple method of making soldered joints of electric conductors. The ends of the wires to be soldered are carefully cleaned and covered with solder. They are then put together into a copper tube with an inside tin lining. This is made out of a spirally wound tinned copper ribbon. The cross-section of this tube exactly fits the form of the two wires to be soldered. Around the copper tube is wound a thin sheet of solder tin and around this a protecting sheet of aluminum. On this is placed an explosive heating mixture of the same kind as is used in matches. This is ignited and burns quickly, and the heat thereby developed causes the tin to melt so that all places between the tube and the wires are filled out. When the joint has become cold the ash is removed, together with the aluminum sheet, and the joint is finished.—*Elek. Zeit.*, Jan. 25.

Wood and Concrete Poles.—W. Manktelow.—The first part of an illustrated article on wood and concrete poles in electrical service. The author discusses the causes of deterioration of wooden poles and means of preserving them by impregnation, giving the details of various tar processes.—London *Elec. Review*, Feb. 2.

Experiments on the Losses Due to Corona on Transmission Lines.—H. Goerges, P. Weidig and A. Jaensch.—An

English translation of their German paper which was recently abstracted in the *Digest*.—London *Electrician*, Feb. 2.

Electrophysics and Magnetism.

Temperature and Magnetic Properties of Carbon Steels.—M. B. MOIR.—An abstract of a paper read before the Royal Society of Edinburgh. After referring to the experiments of Hopkinson, Curie and D. K. Morris, the precautions necessary in magnetic testing are discussed. If the temperature of a test-specimen is changed the specimen must be rendered neutral at the new temperature previous to carrying out the test. Increasing the temperature of a specimen of cast iron from 15 deg. to 190 deg. C. is found to improve its magnetic quality for moderate values of the magnetizing force; from 190 deg. to 260 deg. C. the magnetic quality falls off, after which there is a further improvement. Finally the specimen becomes non-magnetic at the critical temperature. These results are thought to indicate the presence of a transformation point for carbon alloys of iron in the neighborhood of 200 deg. C. Steel containing 1.64 per cent of carbon resembles cast iron in its behavior. The setback in magnetic quality takes place at much the same temperature as that which occurs in cast iron, the magnitude of the setback being much the same for both. Steel containing 0.8 per cent of carbon exhibits the transformation point, but in a less marked degree. (The first maximum point in the susceptibility curve occurs at 180 deg. C. and the first minimum point at 220 deg. C.) Low-carbon steel, containing 0.3 per cent of carbon, shows the transformation point; it is, however, very much less marked than in the case of the steels containing the higher percentages of carbon. The susceptibility temperature curve of a specimen of soft iron containing 0.06 per cent of carbon exhibits no turning points in the neighborhood of 200 deg. C. for fields lying between 2 and 15 c.g.s. units.—London *Electrician*, Jan. 5.

Terrestrial Magnetism.—L. DUNOYER.—An illustrated review of the magnetic exploration of the oceans and the progress made in terrestrial magnetism during the first half of the nineteenth century. After introductory notes on the elementary theories of terrestrial magnetism, the author discusses the theory of Gauss, the maps of Gauss, Sabine, and Erdman, and the research trips of Ross and Dumont L'Urville.—*Revue Gen. des Sciences*, Jan. 30.

Electrochemistry and Batteries.

Iron-Nickel Storage Battery.—C. H. SHARP AND W. E. HOLLAND criticise and refute various points in J. A. Montpellier's Turin Congress paper, in which the iron-nickel storage batteries of Edison and of Gouin were compared in favor of the latter. Montpellier replies to these criticisms.—*L'Electricien*, Jan. 27.

Units, Measurements and Instruments.

Effect of Railway Transport on Alternating-Current Meters.—C. C. PATERSON AND A. KINNES.—An account of tests carried out with the object of seeing if supply meters are detrimentally affected by traveling by road or rail. Eight induction watt-hour meters, of four different makes, were used for the purpose, and each meter was sent on four journeys. The conclusion is reached that the rate of alternating-current meters of the type tested can be relied upon as definite within about ± 0.5 per cent. Small changes in rate take place, but they are quite erratic and as liable to occur when the meter remains on the test bench as when it is sent on a journey by rail or road.—London *Electrician*, Feb. 2.

Shunt.—When using a universal shunt in conjunction with a galvanometer it is best to have the total resistance of the universal shunt not greatly differing from that of the galvanometer, for if the resistances of galvanometer and shunt are disproportionate a loss of sensitiveness occurs. The reason for this is explained.—London *Elec. Engineer*, Jan. 26.

Telegraphy, Telephony and Signals.

Tuning in Wireless Telegraphy.—A. MARINO.—An illustrated description of a new method for electric-wave tuning in wireless telegraphy, based on simultaneous adjustment of the self-induction and capacity of the oscillating circuit.—*L'Electricien*, Jan. 27.

Coupled Oscillators.—JOHN STONE-STONE.—An illustrated mathematical article in which the author derives simple and convenient formulas for the electric dimensions of two coupled oscillation circuits. The formulas for the apparent self-inductions and resistances of the oscillators are analogous to those of the normal transformers.—*Elek. Zeit.*, Feb. 1.

Telephone and High-Tension Lines.—A proposed set of rules for connections of telephone lines to high-tension lines through the intermediary of transformers or condensers, with annotations by H. Passavant.—*Elek. Zeit.*, Jan. 25.

Book Reviews.

LA THÉORIE CORPUSCULAIRE DE L'ÉLECTRICITÉ. By Paul Drumaux. Paris: Gauthier-Villars. 168 pages, 5 illus. Price, 3.75 francs.

An excellent, fairly elementary treatise on the electronic theory. It is more in the nature of a compendium and general review of the subject than of an original composition or new research. Nevertheless, the subject is so clearly dealt with and so ably collated that it ranks with original contributions in its usefulness and value.

The subjects dealt with in the nine chapters of the work are: General considerations; atomic structure of electricity; discharges in rarefied gases; ionization of gases; dynamics of the electron; electro-optical phenomena; radioactivity; conductivity in metals; conclusions. The book will be of interest to all who, familiar with the French language, seek to inform themselves most directly and succinctly upon the nature and principal consequences of the electronic theory.

ELECTRIC TRACTION FOR RAILWAY TRAINS. By Edward P. Burch. New York: McGraw-Hill Book Company. 583 pages; 183 illus. Price, $5.

Although containing a certain amount of material relating to the relative merits of the various schemes that may be employed in operating railway trains electrically, this book is in reality a book of reference for engineers, being almost completely filled with descriptions, statistical tables and notes on the best current electrical literature. Among the subjects treated are the history and present status of electric traction, the characteristics of modern steam locomotives, advantages of electric traction for trains, electric systems available for traction, electric railway motors for trains, motor-car trains, characteristics of electric locomotives, technical descriptions of direct-current, three-phase and single-phase locomotives, power and energy required for trains, transmission and contact lines, steam, gas and water-power plants, procedure in railroad electrification, and work done in railroad electrification.

The information given is remarkably complete and accurate, having been obtained "first-hand" from manufacturers, railroad men, consulting engineers and managers of properties. In addition to the actual data presented and the outline discussions of the comparative merits of the schemes adopted or proposed, the book contains a valuable feature in numerous references to books and periodicals dealing with the subjects of electric-railway equipment and operation. The general method of presentation is one that will appeal strongly to steam-railroad men who desire to study electric motive power and to electrical engineers who wish to be thoroughly posted on the present status of electric traction for railway trains.

New Apparatus and Appliances

ARMATURE AND COIL TESTING SETS.

The advantage of using alternating current for testing purposes is well exemplified by the facility with which armatures and individual coils may be tested for open and

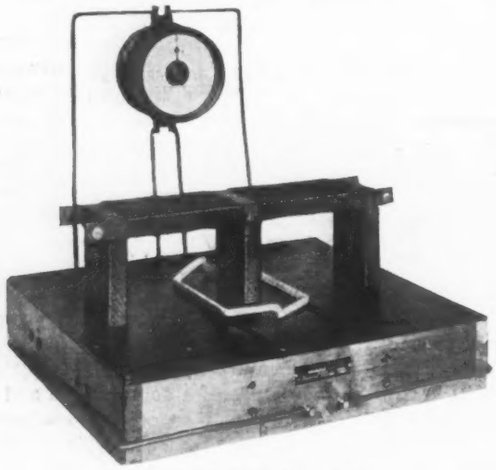


Fig. 1—Coil-Testing Set.

short circuits, using a testing set such as illustrated herewith. The Westinghouse Electric & Manufacturing Company has found these devices so satisfactory in its own works that it has decided to offer them to the trade with the belief that they will prove particularly acceptable.

The sets here described are divided into two classes, one for testing the individual coil and one for the completed

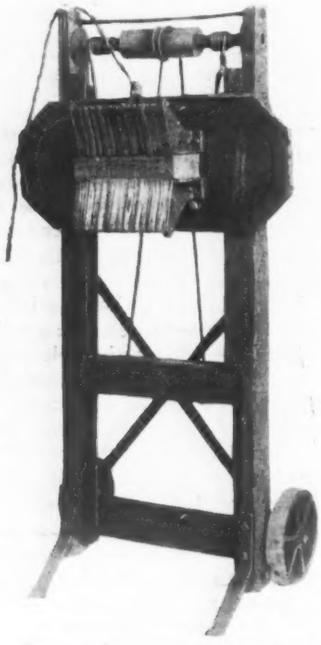


Fig. 2—Armature-Testing Set

armature. A device for locating faults in armature and field coils before the winding is put in place is illustrated in Fig. 1. Its use saves further labor on a defective coil.

The apparatus consists of an E-shaped electromagnet with a detachable yoke. An exciting coil is on the middle leg of the E. On the back of the E, between the middle leg and either outside leg, are wound two small coils so connected that the emfs induced in them oppose each other and accurately balance so that under normal conditions no current flows.

The field or armature coil to be tested is placed over one of the outer legs of the E and the yoke is omitted. If the tested coil is without fault it has no effect on the flux distribution. If, however, a leak or short circuit exists, a current is induced in the tested coil which so alters the distribution of the flux that more passes through one of the detecting coils than through the other, inducing higher voltage in one than in the other and thus causing a current to flow through them. Such current can be detected by means of a zero-center wattmeter or by means of a special telephone receiver. To locate a short circuit in a coil by burning it out the coil is placed on the middle leg of the E, the detachable yoke put in place as shown in Fig. 1 and the exciting coil connected to the line for a short time. The total weight of this coil-testing set is about 275 lb. It occupies floor space of 27 in. by 30 in. and is 14½ in. high over all.

The device for testing complete armatures, illustrated in Fig. 2, consists of a laminated iron core in which an alternating-current magnetic flux is set by connecting the terminals of its exciting coil to a source of alternating current. When either a direct-current or an alternating-current armature of the commutator type is placed against the face of this core, which is shaped to fit an armature, an alternating flux passes through the armature core. If the armature winding is correct the emfs generated counterbalance each other and no current passes through the winding.

Passing a piece of metal or a knife blade around the commutator short-circuits in succession each of the coils that have one side under the testing pole. If there is no fault in the winding a decided spark occurs as the knife blade leaves each bar. Absence of spark between two bars indicates either a short circuit, an open circuit or a reversed coil in the windings. A short circuit or reversal will cause a local current in the coil which will generate a flux around the slots in which the coil lies. Such a local flux can be detected by running over the surface of the armature a piece of sheet iron held lightly, bridging from one tooth to the next successively. A local flux caused by a short circuit or reversed connection will attract the piece of iron when it bridges across the slot containing the defective coil. If no such local flux is detected the fault disclosed by the sparking test is due to an open circuit.

The core is mounted on a stand provided with wheels or on a stationary stand. It is used in a vertical position close to the armature. Two sizes are made, one for armatures up to 12 in. in diameter and one for armatures 12 in. or more in diameter.

COLOR-MATCHING LIGHT.

The General Electric Company, after a research by its corps of trained illuminating engineers and in its extensive laboratories, has evolved a color-matching outfit which has a spectrum stated to be exactly similar to that of "a clear north sky" and a marvel of simplicity.

The device consists primarily of an intensified arc lamp with a special casing and an ingenious arrangement of glass screens that remove the excess of red, orange and violet rays found in the spectrum of the arc light. It is stated that this intensified arc lamp has always been recognized as the nearest approach to daylight of all commercial arti-

ficial illuminants, and thousands are being used in the leading department stores of this country. The addition of the color screen corrects the light absolutely to that of the north light.

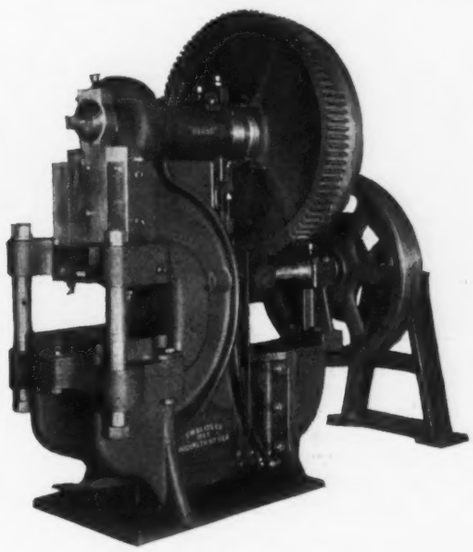
The color screens consist of a number of colored strips, arranged side by side to take out the excess rays, and a diffusing glass whose function is to mix the light. These glasses are made up in the form of a circle about 16 in. in diameter and are placed in the large end of a conical hood which is attached to the casing of the lamp. This hood surrounds the inner globe and has a reflecting surface so that the light is projected down through the color screen and the direct rays are kept from the eyes of the user.

The device has already been standardized for use in all of the mills operated by a corporation which sought relief from the inconstancy of the north light owing to variable weather conditions. The new arrangement gives a direct equivalent of "the light from the clear north sky," and day or night, rain or shine, the turn of a switch places in use a perfect color-matching light, permitting the maintenance of an accuracy of quality which is the desire of every manufacturer.

PUNCH PRESS FOR HEAVY SERVICE.

The press illustrated herewith is arranged to cover nearly every kind of blank cutting, punching, perforating, forming and bending, including a large portion of the operations needed in the manufacture of many articles made of sheet metal. In electrical work it is especially adaptable in all cases where a machine is required for heavy punching.

In order to combine the advantages of the overhanging



Press for Heavy Punching.

frame with those of the straight-sided pattern the press is equipped with stay-rods which are especially desirable when the press is used for embossing, heavy stamping and shaping, but can be removed when the press is used in cutting from full sheets. The belt rim is attached to the gear so that the press is available as either a geared or a flywheel machine. When doing work for which a flywheel press would answer the requirements, the press is arranged as such, being driven as a flywheel press by placing the belt on the pulley rim. The gear in this case acts as a flywheel and the pinion and regular driving pulleys and flywheel are thrown out of mesh.

The machine weighs 10,500 lb. and occupies a floor area of 106 in. by 49 in. It has been developed for the market by the E. W. Bliss Company, Adams Street, Brooklyn, N. Y.

WOODEN INSULATOR.

A novelty consisting of a combined insulator and pin of one piece of wood has been brought out by the Minerallac Electric Company, of Chicago, and is illustrated herewith. The wood is thoroughly impregnated with an insulating compound which gives it, according to the claim of the manufacturer, rather remarkable dielectric properties, at the same time acting as a wood preservative. Several varieties of wood are used, maple being employed in some instances. The impregnation makes the insulator perfectly black in color and gives the surface a somewhat oily feeling. The combined insulator and pin is turned out of a solid piece of wood, and it is asserted that the insulating properties secured after impregnation are better than glass of corresponding size and shape. The new insulator is known as the "Unity" type, and it is declared that insulators made in this manner have been in service on 4000-volt, 9000-volt and 12,000-volt high-tension lines without arcing. Further, it is asserted that some of the earliest installations have been in actual service as long as eight years and show no deterioration in insulating qualities nor any tendency to crack or to split.

Wooden Insulator.

Several practical advantages inhere in this type of insulator and pin. The device is practically non-breakable, and the packing and shipping can be done simply and cheaply. Further, no irreparable damage will be done if the small boy uses it as a target in throwing stones or if a hunter in outlying regions takes a "crack" at it with his shotgun. If the lineman drops the insulator to the ground while at work no harm is done. The mechanical strength is said to be sufficient for ordinary conditions. This insulator was exhibited publicly for the first time at the recent Chicago telephone convention, but it is said to be adapted for other classes of overhead construction work as well as telephone lines.

PILOT CELL FOR VEHICLE BATTERY.

By R. Macrae.

The most important and, as a rule, one of the first questions that is asked by the purchaser of an electric vehicle is how to determine the amount of electricity there is in the battery at any time. It has been necessary heretofore to give an evasive and unsatisfactory answer in order to avoid a discussion of one of the most annoying features of the electric vehicle, namely, the difficulty of knowing at any time how much work the vehicle is capable of doing before recharging is necessary. This uncertainty with regard to the amount of electricity in the battery causes the operator at one time to waste time and energy in charging the battery when charging is unnecessary and harmful, and at another time to undertake to do a certain amount of work with an insufficient supply of electricity, the result being not only failure to do the work, but an additional expense incurred for towing the vehicle to a charging station.

The difficulty experienced in ascertaining at all times the amount of electricity in the battery has done much to retard the general introduction of the electric vehicle. However, there is no difficulty ordinarily in telling the state of charge of a lead battery.

When the surface of the battery solution is open to inspection the readings of a hydrometer floating in the solution will indicate exactly not only when the battery is fully charged, but also what proportion of a full charge there is in it at that time.

In electric vehicles, however, the batteries are usually located in places that are difficult of access, and as the covers of the rubber jars are sealed down close to the surface of the battery solution it is necessary in order to use a hydrometer to draw off a certain quantity of the acid and to test its specific gravity in a separate vessel. As it is obviously impracticable to perform this operation every time that it is desirable to know the condition of the battery, more convenient methods are usually adopted for estimating the state of charge of the battery. For practical purposes these methods as a rule are sufficiently reliable as long as the apparatus is new and in good working order, but the indications obtained from them become misleading and worse than useless when anything happens to be wrong with either the battery or the measuring instruments.

Fig. 1—Pilot Cell.

For this reason, and because it is always necessary to use a hydrometer when the actual condition of the battery has to be determined, it is usual for battery manufacturers to recommend that hydrometer readings of the battery be taken about once a week as a check on more convenient but less reliable methods of operation that may be used from day to day. These recommendations, however, are often entirely disregarded on account of the inconvenience of putting them into practice, and in probably 95 per cent of the cases in which there is dissatisfaction with the operation of an electric vehicle it will be found that the battery has been neglected in this way with the undesirable results that might have been expected.

To render it convenient at all times to ascertain the condition of the battery by means of the hydrometer the pilot cell shown in the accompanying illustration has recently been put on the market.

MILEAGE ON GOOD STREETS	
Gravity	**Miles**
1280	72
1260	60
1240	42
1220	36
1200	24
1180	12
1160	0

Fig. 2—Mileage Card

As will be seen from Fig. 1, this pilot cell consists of an ordinary rubber battery jar which is provided with a hydrometer pocket, the liquid in this pocket communicating with the liquid in the cell through holes in the separating wall of the jar. This hydrometer compartment is provided with a small glass window, through which the readings of the hydrometer can be observed. A suitable guide below the surface of the liquid keeps the stem of the hydrometer central with regard to the glass and prevents the hydrometer from sticking to the sides of the compartment.

Fig. 3 shows the manner in which the pilot cell is used on an ordinary pleasure vehicle. Here the upper strip of the battery tray is cut in two pieces, which are united by a perforated wooden block, through which the hydrometer can be read.

A small card attached to the battery box shows the number of miles that should be obtained from the vehicle for different readings of the hydrometer when the vehicle is in good running order and is operated on well-paved streets. The card for this particular vehicle is shown in Fig. 2. A little experience will soon enable the operator to make proper allowances for unusual running conditions, such as bad roads, frequent stops, etc. The performance of the vehicle falling below what the card calls for is an indication that either the vehicle or the battery needs attention, and this attention should be given to it as quickly as possible.

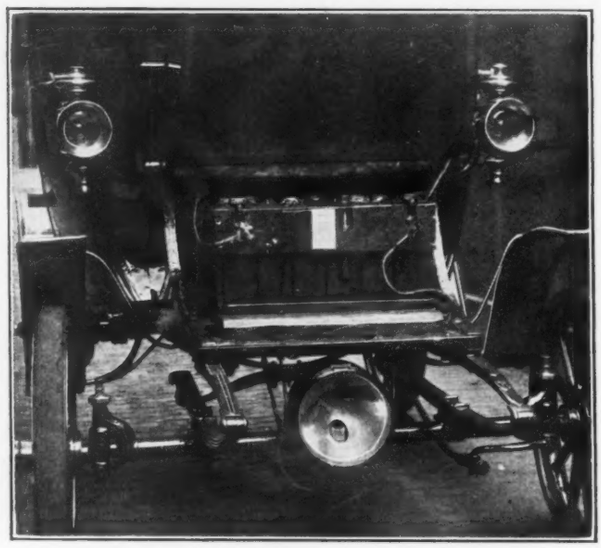


Fig. 3—Pleasure Vehicle Provided with Pilot Cell.

One of the most valuable qualities of a hydrometer is that when it has once been accurately calibrated it always remains accurate. This is not the case with instruments having moving parts, jewel bearings and permanent magnets, especially when these instruments are more or less exposed to the weather and are subjected to the joltings of an electric vehicle.

When the hydrometer indicates that the gravity of the battery is up to its highest point it is quite certain that the battery is fully charged, and when, on the other hand, the hydrometer reading is low it is equally certain that the vehicle will not give its full mileage, no matter what the readings obtained from any other instrument may indicate.

When an electric vehicle is provided with a pilot cell containing a hydrometer it is possible to give definite instructions for charging that are readily understood and easily followed out. There is no excuse either for injury to the battery by overcharging or poor service due to insufficient charge: irregularities in the running of the vehicle are readily detected and the operator is spared many anxious moments in doubt as to whether or not his supply of electricity will prove sufficient to carry him to his destination.

Industrial and Commercial News

BUSINESS, while lacking in briskness, continues to show gradual improvement. Public confidence is increasing rapidly, and the outlook at present is much brighter than was the case a few weeks ago. Railroad officials are reporting very gratifying increases in the tonnage handled, and in several instances February tonnage is expected to show an increase over that in February, 1911. Prospects in the iron and steel trades are still regarded as very favorable, although a slight decrease in inquiries for rails has developed in the past few weeks. This is believed to be only temporary, however, and is attributed to the desire of the roads to await the findings of a committee appointed last week to make recommendations for improving the quality of rails. Moderate improvement is reported in the woolen and cotton industries, and retail business is also showing a slight expansion. Transactions on the New York Stock Exchange during the week have been in the smallest volume since July, 1911, and the movement of prices has also been very narrow. Rates in the money market Feb. 20 were: Call, 2¼@2½ per cent; ninety days, 2¾@3 per cent.

THE COPPER MARKET.

European fortnightly statistics show a decrease in the foreign visible supply of copper of 5,447,680 lb. in the first fourteen days of February. This reduces the total to 119,403,200 lb., the lowest amount in several years. With these figures at hand, the world's visible supply is placed at considerably below 200,000,000 lb., a figure which leads many to believe that a renewal of buying on the part of consumers will be forthcoming within a short time. At present, however, there are no signs of early resumption of buying in large amounts. The market this week has been exceedingly quiet, and no business of moment has been transacted with either domestic or foreign consumers. Electrolytic is still held nominally at 14.30 cents to 14.35 cents delivered thirty days. Many of the leading interests are decidedly surprised at the lack of response to the favorable showing of the January report of the Copper Producers' Association. An inference that is being drawn from the situation is that consumers are well supplied for immediate needs and feel confident of their ability to replenish their stocks when needed, at satisfactory prices. Exports for the month, including Feb. 20, aggregate 26,868 tons. The daily call on the Metal Exchange Feb. 20 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	14.02½	14.07½	.....
February	14.05	14.10	14.07½
March	14.05	14.15	14.10
April	14.05	14.15	14.10
May	14.05	14.15	14.10
June	14.05	14.12½	14.10

The London market, February 20, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	63 0 0	63 0 0
Standard copper, futures	63 13 9	63 13 9

Extreme fluctuations for this year:

	Highest	Lowest.
Standard	14.12½c	13.75c
London, spot	£64 5 0	£60 16 3
London, futures	65 0 0	61 10 0
Best selected	68 5 0	65 5 0

INDUSTRIAL AND COMMERCIAL NOTES.

Federal Light & Traction Company Growing Rapidly.—During the year ended Dec. 31, 1911, the Federal Light & Traction Company, which operates a number of public utilities in the States of Washington, Wyoming, Colorado, Missouri, New Mexico and Oklahoma, and whose home office is at 60 Broadway, New York City, passed through a period of substantial growth and expansion. While the official audit for 1911 has not been completed, returns already at hand indicate that earnings, including the full twelve months' earnings of new acquisitions, will exceed $1,550,000 gross and $630,000 net, as compared with gross earnings of $755,670 and net earnings of $314,156 for the subsidiaries in 1910. A consolidated statement of the earnings of the subsidiary companies for the twelve months ended Dec. 31, 1911, excluding those of the Trinidad Electric Transmission Railway & Gas Company, of Trinidad, Col., which began operations Sept. 1, 1911, shows gross earnings of $1,335,271, operating expenses of $782,404 and net earnings of $552,867. It is therefore likely, judging from this, that when complete returns for 1911 are compiled, they will show that the earnings of the properties controlled by the Federal Light & Traction Company have doubled during the year. As a result of the sale to bankers of $3,000,000 thirty-year, 5 per cent bonds, mentioned in these columns Feb. 10, and the recent sale of $1,500,000 ten-year 6 per cent debentures, the company is now provided with ample funds to meet temporary financing rendered necessary by acquisition of the Springfield Railway & Light Company of Springfield, Mo., and the Trinidad Electric Transmission Railway & Gas Company of Trinidad, Col., and on account of important improvements and extensions made to these and other properties. Sale of these securities has also furnished funds for retiring all outstanding bonds, excepting $2,000,000 Springfield Railway & Light first lien bonds sold last spring, and for immediate needs for improvements, extensions and acquisitions. These new bonds are part of an authorized issue of $50,000,000, the balance of which, reserved for subsequent issue, will be sufficient for the company's needs for some time to come. Progress is being made by the various subsidiaries in the installation of additional equipment and the securing of new business. Contracts executed some time ago by the Sheridan Electric Light & Power Company of Sheridan, Wyo., with coal operators for power purposes, are becoming operative as rapidly as equipment is installed by the mine owners. The street-railroad company at Sheridan, which purchases its energy from the Sheridan Electric Light & Power Company, has been completed and placed in operation. As a result of these two sources of demand, the kilowatt-hour output at Sheridan in January, 1912, was more than double that in the corresponding month of the previous year. Work is going forward rapidly on the 3000-kw plant for the Trinidad company, at Walsenburg, Col., which will serve a territory not heretofore covered, and will be connected with the rest of the Trinidad company's system so as to aid in carrying the present heavy load. The Trinidad company has already contracted for 2,000 hp, which, with other new business in sight, will be cared for as soon as the additional capacity of the new plant can be utilized. All old power contracts have been renewed for at least five years at advantageous rates. The Gray's Harbor Railway & Light Company, of Aberdeen, Wash., operated by the Federal Light & Traction Company, has closed contracts for 290 additional street lamps, including such additional lamps as may be required by the community in the future. The company at Albuquerque, N. M., another Federal subsidiary, has closed a contract for irrigation pumping, which is expected to prove the beginning of a considerable off-peak business. A campaign for special street illumination has resulted in the securing of a number of additional arc lamps, and the prospects for further increase are very good. The Springfield Railway & Light Company has contracted with the Ozark Water & Power Company for a large amount of energy, to be supplied from the latter's hydroelectric development, which is to be built on the White River, 40 miles from Springfield, as noted elsewhere in these columns. The new 2000-kw steam unit recently installed in the power station of the Springfield company, previously mentioned in these columns, will be sufficient to carry the company throughout the present year and will serve as an auxiliary to the hydroelectric plant after the latter is completed. Completion of work of rebuilding the plant operated by the Federal Light & Traction Company at Rawlins, Wyo., will permit considerable economy in operation over the cost in 1911.

Foreign Trade Opportunities.—Several foreign trade opportunities in the electrical field are mentioned in the *Daily Consular and Trade Reports* under recent dates. Schedule No. 8154 states that an electrical engineer in Russia has given information to an American consular officer that a company will be established in the near future for the purpose of selling electric and other goods in European and Asiatic Russia. There will be a central store with branches in various cities throughout the empire. The engineer referred to would like to hear from American firms interested in a proposition to sell their goods. Under Schedule No. 8161 an American consular officer reports that a company in his district will construct a 600-hp steam and hydroelectric plant and also a steam-driven generating station, the capacity of which is not given. Lignite will be used as fuel by the steam plants. This company absorbs the interests of several small electrical concerns, with a substantial increase in capitalization. The same consular officer reports concessions to two other companies for the establishment of electrical plants to distribute energy to various cities. Schedule No. 8166 states that the municipality of Dvinsk, Russia, will receive tenders for the construction of electric tramways. Particulars, specifications, etc., may be obtained from Gorodskaja, Uprawa, Dvinsk, Russia. No time limit is announced for receipt of tenders. Schedule No. 8168 states that the borough council of Poplar, E., London, England, contemplates an extension of the electric generating station, at an estimated cost of $102,196. No particulars are furnished. Schedule No. 8170 states that tenders will be received by the under secretary, Public Works office, Wellington, New Zealand, until May 1, 1912, for furnishing water wheels, switchboard, generators and accessories, together with transformers and an electric crane. Under Schedule No. 8179 an American consular officer reports that a representative of seven German electrical manufacturers desires to secure the agency of some American company making electric heaters, irons, small motors and household articles. Further details on all of the above can be obtained by addressing the Bureau of Manufactures, Washington, D. C.

Byllesby Interests in Colorado.—As previously noted, the interests represented by H. M. Byllesby & Company, of Chicago, have acquired extensive electric-service properties in Pueblo and Canon City, Col., and vicinity. The holding company is the Standard Gas & Electric Company, of Delaware, a thirty-million-dollar corporation. Recently the Arkansas Valley Railway, Light & Power Company has been formed as the operating company. It has acquired the Pueblo Suburban Light & Traction Company, the Colorado Light & Power Company, of Canon City, Rocky Ford Electric Company and La Junta Electric Company. The Arkansas company has franchises to supply electricity to Swink, Manzanola and Fowler and will sell energy at wholesale to the Florence Electric Company. It has also right-of-way franchises for transmission lines in Pueblo, Otero, Fremont and Teller Counties. The water-power plant at Skagway, near Cripple Creek, and the steam plants at Pueblo and Canon City will be operated, other generating plants in the territory served being transformed into substations. In making necessary improvements and extensions in this region Byllesby & Company are doing a large amount of construction work in Southern Colorado.

American Telephone & Telegraph Company Now Controls Missouri Bell Company.—Control of the Bell Telephone Company of Missouri was assumed by the American Telephone & Telegraph Company at the annual meeting of the former on Feb. 20. New directors were elected as follows: U. N. Bethel, vice-president of the American Telephone & Telegraph Company; E. D. Nims, vice-president of the Missouri & Kansas Telephone Compnay; H. J. Pettingill, president of the Southwestern Telephone Company of Texas; C. H. Wilson, general manager of the American Telephone & Telegraph Company, and F. H. Hamilton, of St. Louis.

United Wireless Hearing Postponed.—A hearing scheduled to be held in New York on Feb. 15 before United States Commissioner Alexander for the purpose of examining Christopher C. Wilson, former president of the United Wireless Telegraph Company, as to the present whereabouts of certain of the company's funds was adjourned until March 1. Wilson, as previously noted in these columns, is now serving a term in the federal prison at Atlanta, for using the mails with intent to defraud.

Aluminum Notes and Prices.—Demand for aluminum continues to be moderate and steady. Prices Feb. 19 were 19@20 cents for large ingots for remelting, 31 cents for rods and wire, and 33 cents for sheets.

Canadian General Electric's New Factory.—A permit has been granted to the Canadian General Electric Company to build a three-story factory in Toronto, Ont. It is stated that the cost will be about $87,000.

Financial.

H. L. Doherty & Company to Finance Missouri Hydroelectric Development.—With reference to a statement in these columns in the issue of Jan. 27 to the effect that the Ozark Power & Water Company will build a hydroelectric plant on the White River in the Ozark Mountains of Missouri, it is learned further that this company has been organized under the laws of the State of Missouri, owns the necessary water rights along the White River, has government authority to construct the necessary dam for the proposed development, and that the project is being financed by H. L. Doherty & Company, 60 Wall Street, New York, who are offering the securities of the new company. Details of the plan as given in a letter by the Doherty Operating Company, which will operate and manage the new company, show that the authorized capitalization of the Ozark Power & Water Company consists of (1) $6,000,000 forty-year first-mortgage 5 per cent gold bonds, (2) $500,000 6 per cent cumulative preferred stock, and (3) $1,500,000 common stock. All of the common stock, $375,000 of the preferred stock and $1,500,000 of the bonds become outstanding at once. The securities to be issued at present are to cover the complete cost of a first development of 15,000 hp on the White River, near the town of Forsyth, Mo., together with about 120 miles of distribution system, and the necessary feeders and substations to supply the traction, lighting and power requirements in Springfield, Mo., and to connect in and feed the excess current to the Empire District Electric Company, at Joplin, Mo. It is estimated that the station will be in operation not later than April 1, 1913. Contracts have been made with the Ambursen Hydraulic Construction Company, of Boston, for the complete contruction of the dam and power house at a maximum guaranteed cost. Contracts already made call for the completion of a 50-ft. Ambursen patented reinforced-concrete dam and power house, completely equipped with five 2250-kw, three-phase General Electric generating units, each direct-connected to a pair of 48-in. S. Morgan Smith wheels. Contracts for all necessary exciters, switchboards, transformers and other electrical appurtenances have been placed with the General Electric Company. As regards return upon the investment, H. L. Doherty & Company estimate that gross returns from the first development alone in the year ending April 1, 1914, from business already contracted for and in sight, will be sufficient to yield 4.06 per cent upon the $1,500,000 common stock, after deduction of all charges and expenses. For the year ending April 1, 1915, the estimate is for a dividend of 7.2 per cent on the common stock. Contracts have been executed with the Springfield Gas & Electric Company and the Springfield Traction Company, of Springfield, Mo., controlled by the Springfield Railway & Light Company, which is in turn controlled by the Federal Light & Traction Company, for their power requirements for a term of years, and a contract has also been closed with the Empire District Electric Company for an interchange of energy on terms very satisfactory to both parties. The plan by which subscription to the project is to be made includes the formation under the laws of Delaware, or other suitable state, of a corporation to be known as the Electric Bond Deposit Company, with an authorized capital of $15,000,000, of which $10,000,000 will be 6 per cent cumulative preferred stock and $5,000,000 common stock. The purpose of this company will be to purchase and hold underlying issues upon gas and electric enterprises and to

sell them when their market value is established. The Ozark bonds, $375,000 preferred stock and one-half the Ozark common stock will be sold to the Electric Bond Deposit Company, which will retain it in its treasury, less such part of the common stock as shall be needed by it to pay the expenses of the offering and the originators of the enterprise. The Gas Securities Company, of New York, for a consideration to be paid in common stock of the Electric Bond Deposit Company, has agreed to guarantee the dividends upon $1,500,000 of the preferred stock of the Electric Bond Deposit Company, until such time as the Ozark Power & Water Company shall have earned interest for one year upon its outstanding bonds and dividends upon its outstanding preferred stock. Under the terms of the subscription plan, an offering is made by H. L. Doherty & Company of $500 par value Ozark Power & Water Company common stock and $1,000 par value Electric Bond Deposit Company 6e per cent preferred stock for $1,000 in cash.

Kings County (N. Y.) Electric Light & Power Company's Progress in 1911.—The combined reports of the Kings County Electric Light & Power Company and the Edison Electric Illuminating Company, of Brooklyn, N. Y., all of whose capital stock is owned by the first-named company, for the year ended Dec. 31, 1911, show gross operating revenue of $4,707,914 in 1911, as compared with $4,248,694 in 1910, an increase of $459,219. The surplus available for dividends was $1,024,356, which is equivalent to 10.24 per cent on the capital stock, as compared with $1,009,233, or 10.09 per cent, in 1910. The combined balance sheet as of Dec. 31, 1911, shows assets of $29,288,137, as compared with $27,358,634 in 1910. Anthony N. Brady, president of the company, states that an encouraging feature of the commercial development of the company during the year has been the increase of power business for operating large manufacturing plants. In commenting upon this phase of the company's affairs he calls attention to one large contract secured during the year, which contains a minimum guarantee of $45,000 annually for a term of ten years and will become operative within a few months. According to the report the number of customers at the end of the year was 28,057, as compared with 23,866 at the end of 1910, an increase of 4191. The total connections to the company's system at the end of the year, in 50-watt equivalents, after deduction of 122,478 50-watt equivalents, which were disconnected on account of fire at Dreamland, Coney Island, were 2,142,064, as compared with 2,036,473 in 1910, an increase of 105,591. The number of contracts signed during the year was 15,891, as compared with 14,192 in 1910, and the power contracts written during the year aggregated 19,840 hp, as compared with 17,731 hp written in 1910, an increase of 2,109 hp. The total lighting and power business contracted for during 1911, on a basis of 50-watt equivalents, was 769,115, as compared with 813,992 in 1910, representing a decrease of 44,877 equivalents. The 1910 figures include renewal and succeeding contracts with Luna Park and Dreamland, the Coney Island resorts, totaling 127,477 50-watt equivalents, so that when these are excluded figures for 1911 show an increase over 1910 of 82,600 50-watt equivalents. The total current generated during the year was 105,629,324 kw-hr., as compared with 95,811,402 in 1910; the largest daily output was 425,200 kw-hr., as compared with 373,000 kw-hr. in 1910, and the maximum load in kilowatts in 1911 was 35,500, as compared with 32,500 kw in the year preceding.

Chicago Telephone Company.—The annual report of the Chicago Telephone Company, presented by President B. E. Sunny to the stockholders on Feb. 14, showed gross revenue for the year ended Dec. 31, 1911, of $12,678,390. This is an increase of $1,347,237 over the returns in the previous year. Nearly all of the increase, however, was absorbed in the operating and maintenance cost, leaving net earnings for the year of $2,262,540, which is an increase of only about $7500. The dividends paid in 1911 were $2,160,000, the earnings on the stock being 8.38 per cent. The balance sheet as of Dec. 31, 1911, shows total resources of $40,778,119, of which $33,776,612 is invested in plant. The capital stock liability is $27,000,000 and the bonded debt $5,000,000. The company had 335,652 telephones in service at the end of 1911, an increase of 11.6 per cent during the year. The average gross revenue per telephone during the year was $39.56, and the gross revenue per telephone in the city of Chicago was $41.24 on the average. Both figures show a slight decrease. The falling off in revenue per telephone in the city is attributed by Mr. Sunny to the increase in the number of nickel prepayment telephones. The average revenue from these instruments is $22.70 a year, whereas the operating cost has been computed by experts as ranging from $25 to $28 a year. An important element of expense of maintaining the cheaper class of telephones arises from their frequent removal.

Mackay Defends Postal Telegraph Company.—Clarence H. Mackay, president of the Mackay Companies, said in part at the annual meeting of the stockholders in Boston, Feb. 15: "Some may be disposed to criticise our attitude of open rivalry with the American Telephone and the Western Union. I have been told that our monthly Postal Telegraph publication, in which the oppressive measures of the wire trust were in part exposed, was costing us the friendship of some of our stockholders. My only answer is that we have to-day more shareholders than ever before. For every one we lose we gain three. We have to-day between 7,000 and 8,000 shareholders. The $12,000,000 realized two years ago from the sale of American Telephone & Telegraph Company stock is still preserved intact in cash and in the highest class of securities, including New York City bonds, and the fund is ready for emergencies, extensions or the taking up of a new line of business." The annual report of the company for the year ended Feb. 1, 1912, shows income from investments in other companies of $4,128,490, which is equal to 5.14 per cent on $41,380,400 common stock, after allowing 4 per cent on $50,000,000 preferred stock, as compared with 5.13 earned on the same stock in the preceding year. The balance sheet shows assets of $92,331,238 as compared with $92,303,859 in the previous year.

Philadelphia Company's Financing.—A special meeting of stockholders of the Philadelphia Company, of Pittsburgh, will be held in that city on April 29 to vote upon a proposed increase of the capital stock from $43,400,000 to $73,400,000. The new shares are to be 6 per cent cumulative preferred. A proposition to issue $10,000,000 5 per cent convertible debentures will also be considered at this meeting. This financing is to be in accordance with plans of the company for consolidating all the street-railway companies owned by it and for construction of a generating station in the Pittsburgh district. The consolidation of the traction companies and the issue of new securities will be in line with the desire of the Council of the city of Pittsburgh, and the new money will be expended in harmony with the views of the city authorities. There has been extensive litigation between the city and the railway companies, and the new Council, which assumed office in the latter part of 1911, determined to bring about a satisfactory alliance between the city and the traction corporation.

Proposed Sale of Illinois Tunnel Properties.—Judge Kohlsaat, of the United States Circuit Court, has issued a decree ordering the sale of the property of the Illinois Tunnel Company of Chicago on March 19. This is the company which operates the underground electric-railway freight service in Chicago and also the automatic telephone service. It was placed in the hands of Charles G. Dawes and David R. Forgan as receivers on Dec. 1, 1909, and the sale of the properties has been contemplated for some time. The formal petition for the judicial decree of sale was filed by the Central Trust Company of Illinois, trustee for mortgage holders, whose claims amount to $41,000,000. A reorganization of the property is contemplated, and the formal sale is a necessary step in that proceeding.

Stone & Webster's 1911 Statement.—The combined statement of earnings of the electric-railway, electric-lighting, gas and water-power companies operated under the management of the Stone & Webster organization has been issued for the year ended Dec. 31, 1911, and shows gross earnings of $22,969,868, an increase of $946,742; a balance available for dividends of $5,461,257, an increase of $508,683, and a surplus for the year of $2,093,481, an increase of $26,670. The total connected electric-lighting load in 50-watt equivalents was 2,341,880, an increase of 246,960, and the total connected power load was approximately 130,400 hp, an increase of 18,300 hp.

Cleveland Electric Illuminating Company's Year.—In its fiscal year ended Dec. 31, 1911, the Cleveland Electric Illuminating Company earned a surplus available for dividends of $987,441, which was sufficient to pay the regular 6 per cent dividend on the preferred stock and leave a balance equal to 12.79 per cent on the $7,339,400 outstanding common stock. After deduction of $505,511 for the common-stock dividend, there was left a balance of $433,930. Total deductions from this were $324,559, including $300,000 for depreciation reserve, which left a surplus for the year of $109,371.

Tokio Seeking Funds for Municipal Ownership.—Preliminaries are being arranged in London for a loan of about $45,000,000 to the city of Tokio, Japan, for the purchase by the city of the street railways and electric plants now operated by private corporations. It is stated that $20,000,000 of this sum is to be placed in Paris for subscription, that $15,000,000 will be offered in London, and that the remaining $10,000,000 is to be offered in New York through Kuhn, Loeb & Company. The bonds will bear interest at 5 per cent.

National Carbon Company's Annual Report.—The annual report of the National Carbon Company for the year ended Dec. 31, 1911, shows net income of $931,145, which is a decrease of $372,151 as compared with the net income in the preceding year. Preferred dividends were $315,000, leaving a balance of $616,145, which is equal to 11.2 per cent on $5,500,000 common stock, as compared with 17.9 per cent in the preceding year. At the annual meeting of the stockholders on Feb. 19 retiring directors were re-elected.

United States Lighting & Heating Company's Progress.—In his report to the stockholders on operations in 1911, D. W. Pye, president of the United States Lighting & Heating Company, states that the company has made splendid progress in the introduction of its Bliss axle device and National storage batteries, and that over 2000 cars were equipped during the year with the company's train-lighting devices, making a total of 4500 cars now lighted by this system.

Montreal Tramways & Power Offering.—New York banking interests that have been offering $1,350,000 Montreal Tramways & Power Company 6 per cent three-year collateral gold notes announce that the offering was more than twice over-subscribed.

MARKET PRICES.

	Feb. 14.	Feb. 29.		Feb. 14.	Feb. 20.
Allis-Chalmers	1	⅞	Mackay Companies..	81	82¾
Allis-Chalmers, pf..	7*	6½*	Mackay Cos., pf....	69½*	70*
Amalgamated Cop...	64⅛	65⅛	Philadelphia Elec....	18⅜	18¼
Boston Edison.....299		299	Western Union.....	83⅞	85
C'monwealth Edison.139		142	Westinghouse	71½*	73¼
Elec. Storage Bty..	54½	54½	Westinghouse, pf....120*		120*
General Electric....157		159½			

*Last price quoted.

Personal.

Mr. William Bradshaw, of the Westinghouse company, gave an illustrated talk on electric service meters before the Electrical Engineering Society of Columbia University on Thursday, Feb. 15.

Sir William Ramsay, well known for his researches relating to atmospheric constituents and rare gases, has resigned his position as professor of chemistry at London University, which he held for the past twenty-five years.

Mr. W. W. Lighthipe, of the Otis Elevator Company, will give an illustrated lecture on electric elevators before the Electrical Engineering Society of Columbia University on Feb. 29 at 8:15 p.m. All those interested are invited to attend.

Mr. Francis A. Vaughn, of Milwaukee, read a paper on "Relations of Modern Electric Meter Practice to Consumer, State Commissions and Central-Stations," before the Engineering Society of Wisconsin at its annual meeting in Madison, Wis., on Feb. 16.

Mr. Clayton O. Johnson has been appointed superintendent of the municipal electric-lighting plant of Jamestown, N. Y., succeeding Mr. Charles G. Sundquist, resigned. Mr. Johnson is an electrical engineering graduate of the University of Michigan, class of 1908.

Mr. William W. S. Butler, formerly general manager and engineer of the Newport News & Old Point Railway & Electric Company, and more recently vice-president of the Western States Gas & Electric Company, Stockton, Cal., has been made general manager of the latter company, to succeed Mr. H. E. Adams, resigned.

Mr. Frank F. Fowle was the speaker at the meeting of the Electric Club of Chicago on Feb. 15. At the close of the meeting, on motion of Mr. N. F. Obright, who is a member of the new board of managers, the club, by a unanimous vote, extended its best wishes to Mr. Fowle in leaving Chicago for his new field of labor as associate editor of the *Electrical World*.

Mr. H. W. Butler, who for many years has been connected with one of the largest storage-battery companies in Great Britain, is on a visit to this country. Mr. Butler is particularly interested in the use of the storage battery in transportation and will inform himself of the present state here of both the technical and commercial development of the electric vehicle and the storage-battery railway car.

Mr. Hugh T. Brown, formerly of the Nashville office of the General Electric Compnay, has opened an office in that city as consulting, mechanical and electrical engineer. Mr. Brown has had over eighteen years' practical experience with both manufacturing and operating companies, having been associated with the Williams-Middendorf Syndicate and with Stone & Webster as well as the General Electric Company.

Mr. E. P. Chalfant, formerly president of the E. R. Thomas Motor Car Company, has been elected president and director of the Springfield (Mo.) Railway & Light Company, president and director of the Sharon & New Castle Street Railway, Sharon, Pa., and director of the Youngstown-Sharon Railway & Light Company. Mr. Chalfant will become associated with Mr. Harrison Williams, New York, N. Y., in the financial and public utility companies.

Mr. William H. Lyons, industrial engineer in the employ of the Rochester (N. Y.) Railway & Light Company, has severed his connection with that company and accepted the position of industrial engineer of the Portland (Ore.) Railway, Light & Power Company. Mr. Lyons is a graduate of Cornell University and went to Rochester immediately after his graduation in 1909. A banquet was tendered to him on Feb. 15 by his associates in Rochester prior to leaving for the Pacific Coast.

Obituary.

Mr. Frederick W. Wolf, founder and president of the Fred W. Wolf Company, of Chicago, manufacturer of refrigerating machinery, died at his home in Chicago on Feb. 17. He established his business, which grew eventually to large proportions, in 1865. Mr. Wolf was seventy-four years old.

Mr. A. C. Folsom, secretary and manager of the Pontiac Light & Water Company, of Pontiac, Ill., dropped dead in Pontiac on Feb. 16. Mr. Folsom, who was fifty years old, was active in Chautauqua work, being president of the International Chautauqua Alliance and organizer of the first Chautauqua Association in the State of Illinois.

Mr. F. H. Strieby, of the Cincinnati office of the General Electric Company, died Sunday, Feb. 18, after a few days' illness. Mr. Strieby was one of the pioneers in electric work, having installed many of the early street railway systems in this country. He was well known in railway and electric circles and had many friends in the commercial and engineering world.

Mr. Augustus G. Davis, for many years owner of the Viaduct Electric Plant at Relay, Md., died last week in Elkridge. Mr. Davis was born in Waterford, N. Y., seventy-eight years ago and came to Baltimore in 1870. He is said to have established the first telephone exchange in Baltimore and to have operated the first electric car run in that city.

Prof. John Burkitt Webb, who resigned from the department of mathematics and mechanics at the Stevens Institute of Technology five years ago to practise his profession of consulting engineer, died in Hoboken, N. J., on Feb. 18, at the age of seventy-one years. Professor Webb was the inventor of many devices used in the measurement of power, the Webb dynamometer being, perhaps, the one best known. He graduated from the University of Michigan in 1871, and supplemented his course by extensive study at the universities at Berlin, Heidelberg and Paris.

Mr. Lee D. Fisher, right-of-way agent for the Public Service Company of Northern Illinois, died at his home in Joliet, Ill., on Feb. 8. Mr. Fisher was an engineer of unusual ability, and his untimely death is sincerely regretted by his associates. He was born in Elyria, Ohio, in 1875, but spent his boyhood and youth in St. Louis, where he graduated from the electrical and mechanical engineering courses of Washington University in 1897. He was a Spanish-American War veteran and was chief engineer of the transport *Buffalo* during the war and the subsequent operations in the Philippines. In 1900 Mr. Fisher engaged in electric-railway construction, and he was the engineer in charge of the building of three lines radiating from Columbus, Ohio. In 1903 he aided in building the Joliet, Plainfield & Aurora interurban railway and also the Joliet & Southern Traction Company's line. He became treasurer and chief engineer of the company last mentioned, of which his father, Mr. H. A. Fisher, is president. He had made his home in Joliet for several years, and a few months ago accepted the position of right-of-way agent with the Public Service Company of Northern Illinois, an important position in view of the expanding operations of that large company. He died after an illness of only a few weeks, heart disease being given as the cause. In addition to his parents, Mr. Fisher is survived by a widow and two young children. The funeral was held in St. Louis on Feb. 10.

Mr. Francis H. Stillman, president of the Watson-Stillman Company and a prominent figure in the metal trades, died suddenly Feb. 18, 1912, of intestinal hemorrhage at his residence, 105 Rodney Street, Brooklyn, in his sixty-second year. He was born in New York City Feb. 20, 1850, and was graduated from Yale in the class of 1874 with the degree of B. S. In 1883 he formed the firm of Watson-Stillman Company, manufacturers of hydraulic machinery; the firm is still in existence and is prominent in the trade. He was a member of the Hanover Club of Brooklyn, the Engineers' Club and the American Society of Mechanical Engineers, and was treasurer and director of the National Association of Manufacturers since 1903. He organized the Machinery Club of New York and was its first president. Mr. Stillman was the first president of the National Metal Trades Association. In addition to being president of the Watson-Stillman Company he was president of the Bridgeport Motor Company, of Bridgeport, Conn., president of the Pequannock Commercial Company, and a director in other manufacturing firms and of the Manufacturers' Association of New York. He was a member of Hyatt Lodge, F. and A. M., a member of the Thirty-second Degree Brooklyn Consistory, a Knight Templar, a noble in Kismet Temple, Mystic Shrine, and a member of the Royal Arcanum. He is survived by his widow, formerly Miss Irene A. Bancroft, of Boston, and two sons, Edwin Arthur and Austin Frank Stillman.

Mr. Arthur W. Ballard, president of the Pacific Gas & Electric Company, of Phoenix, Ariz., committed suicide in that city on Feb. 8, as noted in last week's issue. He was apparently cheerful during the day and parted from his wife affectionately when leaving home for his place of business. Going through the dynamo room to his office, he greeted several employees pleasantly. He had been in his office but a short time when the reports of shots were heard, and on rushing in the workmen found Mr. Ballard dead at his desk, shot through the heart, with an automatic revolver on the floor. It is believed that despondency due to ill health caused Mr. Ballard to take his life. He was a former resident of Los Angeles and was a member of a well-known family in that city, several members of which are connected with public-utility companies. His brother, Mr. R. H. Ballard, is secretary and manager of the Southern California Edison Company. Mr. Ballard had the reputation of being a considerate employer, and it is said that among the papers found on his desk was an order for an increase of employees' pay, which he had prepared evidently just before he shot himself. It is believed that his business affairs are in excellent condition. He was in personal charge of his properties and he had developed the Pacific Gas & Electric Company until it is said to be the largest concern of the kind in the State. This company buys part of its power from the United States Reclamation Service, hydroelectric energy from the Roosevelt dam of the Salt River project being utilized. Mr. Ballard was an associate of the American Institute of Electrical Engineers and was a member of the California, Jonathan and Union League clubs of Los Angeles. He leaves a wife and a young daughter.

Prof. Henry Taylor Bovey, well known in this country for his educational work while dean of the department of applied science at McGill University, Montreal, Canada, died at Eastbourne, England, on Feb. 2. Professor Bovey was born in Devonshire, England, on March 7, 1852, and hence was in his sixtieth year at the time of his death. He graduated from Cambridge University, with high honors in mathematics and was made a fellow in Queen's College. He was for a time assistant engineer of the Mersey Docks and Harbor Works and was appointed professor of civil engineering and applied mechanics at McGill University in 1877. In 1878 he was made dean of the newly constituted department of applied science, which developed with rapidity under his leadership, which continued until 1908. In this year Professor Bovey was appointed rector of the Imperial College of Science and Technology in London. Professor Bovey was an honorary LL.D. of McGill University and Queen's College and D.C.L. of Bishop's College. He was elected Fellow of the Royal Society of London in 1902 and honorary Fellow of Queen's College in 1906. He is survived by a wife, two sons and three daughters.

PROF. H. T. BOVEY.

Mr. Samuel Morris Dodd, the first president of the Wagner Electric Manufacturing Company, which position he held continuously until the present year, died on Feb. 12 at the age of seventy-nine years. Mr. Dodd was identified for more than fifty years with St. Louis corporations, including in recent years the National Bank of Commerce, the American Central Insurance Company, the Commonwealth Trust Company and the Title Guarantee & Trust Company. He organized and for many years headed the Missouri Edison Electric Company, retiring from the management when that company was sold to the North American Company. It was the urgent need of the Missouri company for better distributing transformers in 1891 that led Mr. Dodd and some other officers and stockholders of that corporation to lend their support to Mr. A. H. Wagner and his associates in extending their manufacturing business into the field of transformer work, which led to the formation of the Wagner Electric Manufacturing Company with an initial capital of $25,000. Mr. Dodd became its first president and guided it through the vicissitudes to which the new company was exposed along to the point of importance and stability now characteristic of the company. During the present year Mr. Dodd resigned as president of the company, to be succeeded by Mr. W. A. Layman, but remained chairman of the board of directors.

S. M. DODD.

Construction.

GADSDEN, ALA.—The Gadsden Car Works contemplate improvements to their plant, including the installation of an electric-light plant. The cost of the work is estimated at $20,000.

MONTGOMERY, ALA.—The City Council has awarded the contract for street-lighting to the Montgomery Lt. & Wtr. Co. for a period of 10 years. The company agrees to furnish 4-amp magnetite arc lamps at $22.50 each per year. The city now pays $51 per lamp per year.

PHOENIX, ARIZ.—The Salt Lake River Valley El. Ry. Co. has applied for a franchise to the Board of Supervisors to build the proposed White line to Mesa and Scottsdale. W. S. Furman is interested.

EUREKA SPRINGS, ARK.—The Kings River Pwr. Co., which is building a hydroelectric plant on Kings River, 5 miles from here, has applied to the City Council for a franchise to supply electricity for lamps in Eureka Springs.

HARRISON, ARK.—The electric plant of the Harrison El. Lt. & Ice Co. was wrecked recently owing to the breaking of a piston rod on an engine. The loss is estimated at about $25,000.

HALF MOON BAY, CAL.—The Halfmoon Bay Lt. & Pwr. Co. has applied to the Board of Supervisors of San Mateo County for a franchise to erect a transmission line from Rockaway Beach to the San Francisco County line, bids for which will be received until April 1. The company was the only bidder for the franchise to construct a transmission line from Montara to Rockaway Beach, for which it paid $25.

OAKLAND, CAL.—The Board of Supervisors has sold a franchise to the Oakland Trac. Co. for an electric railway along Arlington Road from the Berkeley city line to Alameda Contra Costa line.

REDWOOD CITY, CAL.—The Great Western Pwr. Co. has applied to the Board of Supervisors of San Mateo County for a 50-year blanket franchise to operate in this county. Bids for the above franchise will be received until April 1. The Halfmoon Bay El. Lt. & Pwr. Co. has also petitioned for permission to erect poles over the mountain to San Mateo, there to connect with the system of the Great Western Pwr. Co.

RED BLUFF, CAL.—The installation of a municipal electric-light plant in Red Bluff is under consideration.

ROSEVILLE, CAL.—The City Council has passed a resolution authorizing the city engineer to prepare plans and specifications and advertise for bids for the construction of a municipal power station. The Pacific Gas. & El. Co. has refused to sell its plant and distributing system to the city.

SANTA CRUZ, CAL.—The City Council has granted the Ocean Shore Ry. Co. a franchise to operate in this city.

SANTA ROSA, CAL.—The City Council has granted the Great Western Pwr. Co. a franchise to operate an electric system here. The company proposes to submit a proposition to the Council for street lighting soon.

STOCKTON, CAL.—The City Council has granted the Tidewater & Southern R. R. Co. a franchise to build an electric railway on Pilgrim Street.

TROPICO, CAL.—A proposition has been submitted to the City Council by Herman Paine, manager of the local basket factory, to supply electricity for an electric lighting system to be owned and operated by the city. Mr. Paine states that the waste material from the factory would supply sufficient fuel to operate a power plant to run the factory and also to supply electricity to light the city.

VENICE, CAL.—The Venice Booster Club has applied to the Board of County Supervisors to light the Washington Boulevard between Los Angeles and Venice and to make other improvements.

KERSEY, COL.—The Kersey Ice Co. has applied to the Town Board for a franchise to install an electric-light plant. An election will be called to vote on the proposition.

PUEBLO, COL.—The control of the electric power plants in the Arkansas Valley has been secured by the Standard Gas & El. Co. of Delaware, which is controlled by W. H. Byllesby & Co., Chicago, Ill., through the organization of the Arkansas Valley Ry., Lt. & Pwr. Co. as a subsidiary. The merger includes the Pueblo Suburban Lt. & Trac. Co., Pueblo; the Colorado Lt. & Pwr. Co., Canon City; the Rocky Ford El. Co., Rocky Ford; the La Junta El. Co., La Junta; the electric-light franchises in Swink, Monzanola and Fowler, through which new transmission lines will be erected. All plants with the exception of those at Pueblo, Canon City and Skaguay, the latter a hydroelectric plant above Cripple Creek, have been closed and will be replaced by substations. The steam plants at Pueblo and Canon City will supply electricity for the entire district.

LYME, CONN.—The New London & East Lyme St. Ry. Co. contemplates extending its railway from Lyme to Flanders. L. G. Rudd, New London, is superintendent.

MILFORD, CONN.—The Board of Selectmen has voted to enter into a contract with the United Illg. Co., Bridgeport, for street lighting for a period of one year. The contract calls for 100 electric lamps to replace the gas lamps now in use.

WINSTED, CONN.—The borough of Winsted has awarded a contract to the Winsted Gas Co. for street lighting for a period of five years. The contract calls for the installation of new and modern lamps.

WILMINGTON, DEL.—The Wilmington & Philadelphia Trac. Co. is preparing to install an additional 1000-kw motor-generator set at its Fifth Street plant in Wilmington.

WASHINGTON, D. C.—An American consular officer in a Latin-American country reports that an electric light and power plant is to be established to supply electricity for lighting several towns in his district. For further information address No. 8111, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

WASHINGTON, D. C.—A report from an American consul in a European country states that a firm in his district wishes to communicate with manufactures of dynamos, electric elevators, apparatus for electric-lighting, installations, etc. For further information address No. 8119, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

WASHINGTON, D. C.—A report from an American consul in a Latin-American country states that negotiations are under way with regard to a concession for the establishment of a telephone system in his district. If negotiations are successful, a new and complete telephone system will be installed. For further information address No. 8113, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

WASHINGTON, D. C.—An American consular officer reports that a firm in a Latin-American country states that it has in hand a transaction in electrical apparatus and has requested to be placed in communication with an American house in a position to obtain supplies of various kinds from competent American manufacturers. For further information address No. 8122, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

AMERICUS, GA.—The City Council has decided to hold an election on March 20 to vote on the proposition to issue $60,000 in bonds to establish a municipal electric-light plant here.

ATLANTA, GA.—The Henan Destruction Co., New York, N. Y., has submitted a proposition to the Board of Health offering to build a crematory plant which will dispose of all of the city's garbage and at the same time furnish steam power to generate sufficient electricity for lighting the city and to operate the pumping plant at the Hemphill station, at a cost of about $400,000. W. L. Gilbert is president of the board of health.

ROYSTON, GA.—The Franklin Lt. & Pwr. Co., recently organized, is planning to develop water-power properties on Broad and other rivers in Franklin and Hart Counties. About 5000 hp will be developed, which will be transmitted to Royston, Carnesville, Cannon and Bowersville. The company is capitalized at $150,000, with privilege to increase capital to $1,000,000. The promoters are: W. W. Lotspeich, M. H. Terrell and U. S. Seal.

EMMETT, IDAHO.—The W. H. Rosecrans Engineering Co., 30 North La Salle Street, Chicago, Ill., is preparing plans and specifications for replacing all wooden structures in the system of the Emmett Irrigation District with metal flumes, siphons, etc.

EMMETT, IDAHO.—Plans and specifications are being prepared by the W. H. Rosecrans Engineering Co., 30 North La Salle Street, Chicago, Ill., for the construction of a 10,000-hp hydroelectric plant on the Payette River, near Boise, for C. L. Tallmadge, 37 Wall Street, New York, N. Y. Bids will be received in about 30 days.

BLANDISVILLE, ILL.—The Board of Trustees has granted a 15-year franchise to L. J. Highland to install an electric-light plant here. Under the terms of the franchise 40-watt tungsten street lamps will be furnished at $12 each per year, for 100 or more. Electricity for lamps will be supplied at the following rates: For the first 25 kw-hr., 12 cents per kw-hr.; 10 cents for the next 25 kw-hr.; 9 cents for the next 20 kw-hr.; 8 cents for the next 20 kw-hr. and 6 cents per kw-hr. for all over 100 kw-hr.

CHARLESTON, ILL.—Negotiations have been closed whereby the Central Illinois Pub. Ser. Co. is to take over the property of the Charleston Illg. Co. and the utilities companies operating in Paris and Kansas. Later plants in other Illinois cities will be taken over by the company. The Central Illinois Pub. Ser. Co. is now operating an electric railway between Charleston and Mattoon. The deal means that funds will be provided for building the Charleston-Paris line this year or next and also for the construction of the Paris-Chrisman line.

CHICAGO, ILL.—It is reported that the Interstate Independent Tel. & Teleg. Co. will be consolidated with the Illinois Tunnel Co. Two new automatic exchanges are planned for the South Side, and it is expected that the entire city will be covered with the automatic system within a year.

FLORA, IND.—The Kehoe Lt. & Pwr. Co. has been granted a 25-year franchise to supply electricity in Flora.

OTTERBEIN, IND.—The County Commissioners have granted a franchise to the Otterbein Ltg. Co. for the erection of an electric transmission line from the power house of the Indiana Ltg. Co. to Otterbein to supply electricity for lamps and motors in this town and vicinity. The Indiana Ltg. Co., Lafayette, will supply energy to operate the system.

TERRE HAUTE, IND.—The Retail Merchants' Association has appointed a committee to make investigations and secure estimates of

the cost of installing an ornamental street-lighting system in the business district.

YORKTOWN, IND.—Preparations are being made by the Union Trac. Co., it is said, for the installation of an electric-light system here as soon as the weather will permit.

ANAMOSA, IA.—F. J. Cross, owner of the Central City electric plant, has applied to the City Council for a franchise to supply electricity for lamps and motors here.

ANITA, IA.—P. A. Johansen, Atlantic, Ia., has applied to the Council for a franchise to install and operate an electric-light plant here.

BURLINGTON, IA.—The installation of an electrolier lighting system on Jefferson Street is under consideration.

COUNCIL BLUFFS, IA.—The City Council has decided to install flaming-arc lamps on West Broadway from Twelfth Street to the Missouri River Bridge. About 40 lamps will be required.

HOPKINTON, IA.—Milroy Brothers, owners of the local electric-light plant, will soon establish a 24-hour service for lamps and motors.

IOWA CITY, IA.—The installation of a cluster street-lighting system on the business streets is under consideration by the business men.

JEFFERSON, IA.—The Jefferson El. Co. is contemplating improvements to its plant, to cost about $20,000. Percy Gray is owner and manager.

MUSCATINE, IA.—Plans are being considered for a large hydroelectric power plant in connection with the Moscow canal project. The Federal Construction Company proposes to apply to the City Council for a franchise to operate in this city. It is expected that the canal project will develop 30,000 hp and will divert the water of the Cedar River to the Mississippi River, passing through Muscatine.

NEVADA, IA.—Negotiations have been practically closed for the disposal of the plant of the Nevada El. Co. to Des Moines parties, headed by James G. Berryhill, Jr. The plant will be consolidated with the Ames and Boone plants, which are controlled by the same interests.

RALSTON, IA.—Application has been made to the Council by M. Johnson, of Leon, for a franchise to install and operate light and power plant here.

SLATER, IA.—The question of establishing a municipal lighting plant here is under consideration. A committee has been appointed to make investigations for same.

EL DORADO, KAN.—The City Council is contemplating the installation of a municipal electric-light plant to be operated by water-power. J. S. Worley, of Worley & Block, Kansas City, has been engaged to make investigations of the water-power of Walnut River with a view of utilizing it for that purpose. It is also proposed to operate the pumping station by water-power.

LANSING, KAN.—The Leavenworth Lt., Ht. & Pwr. Co., Leavenworth, contemplates extending its system to Lansing.

MINNEAPOLIS, KAN.—Negotiations are under way between the City Council and the Jackman Roller Mills, Minneapolis, with a view to the Council taking over the electric plant of the Jackman Roller Mills, to be owned and operated by the municipality. Bonds to the amount of $15,000 have been voted to establish a municipal plant.

HAGERSTOWN, MD.—The directors of the Hagerstown R. R. Co. have decided to erect a union power plant, to cost about $1,000,000, to furnish electricity for the Hagerstown R. R. Co., the Frederick R. R. Co. and also for manufacturing purposes in both Frederick and Washington Counties. J. G. White & Co., New York, N. Y., engineers, have recommended that the proposed plant be located in Security. It is understood that the present plans provide for a 3000-kw steam power plant. Henry Holzapfel, Jr., is president of the Hagerstown R. R. Co.

LOWELL, MASS.—The city of Lowell has petitioned the State Legislature for authority to construct, maintain and lease conduits for electric wires and cables.

ALLEGAN, MICH.—Extensive improvements are contemplated by the Commonwealth Pwr. Co. to the local plant, including the installation of new transformers, wiring, poles and machinery. Power for operating the system will be received from the Trowbridge plant while repairs are being made.

SPARTA, MICH.—At a special election held Feb. 5 the citizens voted to grant the Grand Rapids-Muskegon Pwr. Co. a 30-year franchise to supply electricity for lamps and motors here.

BIWABIK, MINN.—Bids will be received by the Village Council until March 9 for furnishing and installing an ornamental street-lighting system for five blocks on Main Street, using ornamental lamp standards each carrying five lamps. It is estimated that 36 standards will be required. J. E. Riley is village clerk.

WABASHA, MINN.—The Minnesota-Wisconsin Pwr. Corpn. has applied for a franchise to enter this city. H. J. Paine is city recorder.

ELLISVILLE, MISS.—The Board of Aldermen has adopted a resolution to sell the municipal electric-light plant to the Laurel Ry., Lt. & Pwr. Co. The company agrees to supply electricity upon the same terms as in Laurel and is to be given a franchise to build an electric interurban railway into this city extending to the Agricultural High School.

CORDER, MO.—A proposition has been submitted to the Commercial Club of Corder City by Gilbert Kleinschmidt for lighting the streets and business places with electricity.

EDITH, MO.—It is reported that plans have been prepared for the erection of a large hydroelectric power plant on the Big Niaugua River, about 1½ miles from Edith. The cost of the dam alone is estimated at $1,000,000, land for it having already been secured by Walter Bray and E. F. Robertson, of Springfield, Mo.

JEFFERSON CITY, MO.—The McKinley Traction System has purchased the property of the Jefferson City Lt., Ht. & Pwr. Co. It is understood that the McKinley system is negotiating for the purchase of the Jefferson City Bridge & Tran. Co., which operates the street railway.

AUBURN, NEB.—The City Council is considering the question of installing an ornamental street-lighting system.

DE WITT, NEB.—Plans are being considered for the installation of an electric-light plant here. It is proposed to organize a company with a capital stock of $10,000 to operate the proposed plant.

EDGAR, NEB.—R. T. Williams and others are interested in a proposition to erect a power plant on the Blue River to supply electricity here. It is proposed to build a concrete dam at the site of the Blue Bluff mill and to develop about 700 hp. The cost of the plant is estimated at about $50,000.

LOUP CITY, NEB.—The City Council has granted the Loup City Mill & Lt. Co. a franchise to install and operate an electric-light plant here. The power plant will be located on the Calumus River and energy transmitted across the country to Loup City.

LACONIA, N. H.—The Laconia Gas & El. Co. has applied to the Public Service Commission for permission to issue $80,000 in additional capital stock.

PORTSMOUTH, N. H.—The Rockingham County El. Lt. & Pwr. Co. has been granted permission to erect transmission lines from Cable Road to Rye Center and from the "Y" to the North Hampton station on the poles of the local electric railway.

PATERSON, N. J.—A bill will soon be introduced into the State Legislature providing for the construction of a lighting plant for Passaic County. Plans have been submitted estimating that a plant with sufficient output to maintain 1650 lamps could be built for about $148,700 and could be operated for $61,000 per year.

PHILLIPSBURG, N. J.—The capital stock of the Phillipsburg El. Lt., Gas, Pwr. & Htg. Co. has been increased from $30,000 to $100,000.

DEMING, N. M.—The Federal Lt. & Trac. Co. has purchased the property of the Deming Ice & El. Co. The new owners propose to enlarge the plant at once so as to supply electricity for operating pumping plants for irrigating purposes in the Mimbres Valley. R. E. Cameron is manager of the Deming plant.

ALBANY, N. Y.—Sealed proposals will be received by the secretary to the Trustees of Public Buildings, Albany, N. Y., until March 18 for certain work in connection with the reconstruction of the State Capitol, Albany. A separate proposal is required for each of the following items: (A) Heating and ventilation; (B) plumbing and drainage; (C) electric light and power wiring; (D) electric elevators and elevator fronts; (E) metal window frames, sash and glazing. Plans and specifications and blank forms of proposals may be obtained by application to Franklin B. Ware, state architect, Albany, N. Y. A deposit of $5 will be required for each set of plans. For plans and specifications of complete work a deposit of $25 will be required.

BIG FLATS, N. Y.—Plans are being considered for establishing a lighting district here, to be lighted by electricity.

ELMIRA, N. Y.—It is understood that the new street-lighting contract will provide for the installation of cluster lamps in the business district.

ENDICOTT, N. Y.—The Board of Trustees has granted the Endicott Lt., Ht. & Pwr. Co. a 50-year franchise to supply electricity for lamps and motors here. Work will begin at once on construction of a plant.

LESTERSHIRE, N. Y.—Plans and specifications have been prepared for the proposed boulevard lighting system which provide for the construction of a conduit from Willow Street to Arch or Baldwin Street, and for 24 lamp standards, installation of lamps, etc.

NEW YORK, N. Y.—The Bronx Trac. Co. has been granted a franchise by the Board of Estimate to construct and operate an electric railway along Westchester Avenue to Eastern Boulevard in the borough of the Bronx.

ROCHESTER, N. Y.—The Rochester Ry. & Lt. Co. is planning to build a duplicate underground cable system to supply electricity to the 11,000-volt line extending from Rochester to Sodus. The cost of the work is estimated at $15,000.

SCOTIA, N. Y.—The Schenectady Illg. Co. has submitted a proposition to the Board of Trustees offering to change the present street-lighting system to a tungsten-lamp system.

WAPPINGERS FALLS, N. Y.—A petition is being circulated asking the Town Board to establish a new lighting district, covering an area of about 4 miles, and also to enter into a contract with the Garner Print Works and Bleachery to supply the lighting service. The Garner company contemplates enlarging its plant and raising its dam.

KENMARE, N. D.—The Kenmare Lt. & Pwr. Co., operated by the National Briquetting Co. of Minneapolis, Minn., may possibly erect a transmission line to Bowbells, 10 miles distant, if that city decides to purchase electricity in bulk. Plans are being considered for utilizing exhaust steam for commercial heating when the plant is moved into the city. J. W. Hopkins is supervising engineer.

CLYDE, OHIO.—The Board of Public Affairs has engaged George Champe, engineer, Toledo, to prepare plans and specifications for a new municipal electric-light plant here.

ELYRIA, OHIO.—All bids received Feb. 12 for the construction of transmission line, transformers, meters, etc., and for furnishing and installing complete wiring, fixtures and distribution for electric lighting at Lorain County Infirmary were rejected by the Board of County Commissioners. New bids will be called for soon. T. L. Gibson is county engineer.

STONEWELL, OKLA.—The City Council is reported to have granted a franchise to a company for the installation of an electric-light system here. Power for the proposed plant will be secured from Boggie Creek, about 2½ miles distant. J. A. Cowling and others are interested in the company.

CARLTON, ORE.—The citizens have voted to amend the present charter of the city to allow an issue of $40,000 in bonds for water and light systems. The reservoir will be located on Panther Creek, about 7½ miles from the city. A. L. Richardson, of Portland, is engineer in charge.

MEDFORD, ORE.—The California & Oregon Pwr. Co., which has purchased the property of the Siskiyou El. Co., the Rogue River El. Co. and 23 other small electric companies in southern Oregon and northern California, thus gaining control of electric power in the district south of Grants Pass, Ore., and north of Dunsmuir, Cal., is planning to develop 250,000 hp from the streams in that territory. The main office of the company is in San Francisco. J. M. Churchill, of Yreka, Cal., is president, and Alexander Roseborough, Oakland, Cal., secretary.

PENDLETON, ORE.—A company has been organized under the name of the Interior El. Pwr. Co. for the purpose of establishing an electric power plant to supply electricity for commercial purposes in Pendleton and Milton. The proposed plant will be located on the Walla River, 6 miles above Milton. Service will also be supplied to residents between the two cities.

PANAMA.—All proposals received at the office of the Isthmian Canal Commission, Washington, D. C., for furnishing automatic signal material for the relocation of the Panama Railroad, relating to Circular No. 669, will be returned to bidders unopened. Major F. C. Boggs is general purchasing officer.

MEYERSDALE, PA.—Three applications for franchises for lighting the borough have been presented to the Council. The Meyersdale El. Lt., Ht. & Pwr. Co. has asked for a renewal of its franchise, which up to the present time has not been granted. The second application was made by the Consumers' El. Co. and the third by the Glade Valley El. & Pwr. Co., which offers to supply arc lamps of 2000 cp at $50 each per year. The borough now pays $60 each per year for arc lamps.

NEW CASTLE, PA.—The Pennsylvania Pwr. Co., Ellwood, Pa., is preparing to submit bids to the City Council for street lighting here. If it secures the contract in New Castle, it will enlarge its present plant or erect a new one in New Castle.

PITTSBURGH, PA.—Negotiations have been closed whereby the property of the Duquesne Lt. Co., of Pittsburgh, will be taken over by Mason B. Starring, president of the United Railways Investment Co. of New Jersey.

PLYMOUTH, PA.—The Luzerne Ht., Lt. & Pwr. Co., Plymouth, has submitted a proposition to the town authorities of Wapwallopen offering to extend its service to that place. It is proposed to erect a transmission line from the power plant at Shickshinny to Wapwallopen.

SHARON, PA.—At an election to be held April 13 the proposition to issue bonds for the installation of a municipal electric-light plant will be submitted to a vote.

UNIONTOWN, PA.—Investigations are being made by the Chamber of Commerce of the tungsten lamp cluster system of street-lighting and also of ornamental lamp standards with a view to advocating the installation of an improved street-lighting system here.

WOMELSDORF, PA.—The capital stock of the Womelsdorf & Rehrersburg Rural Tel. Co. has been increased from $5,000 to $50,000.

CAMDEN, S. C.—The proposition to issue $100,000 in bonds for the installation of an electric-light plant and water-works system will be submitted to a vote in April.

SELMER, TENN.—The electric-light service, which was discontinued in May, 1911, will be established again about March 1.

NACOGDOCHES, TEX.—At an election to be held March 12 the citizens will vote on the proposition to issue $60,000 in bonds for improvements to street-lighting system, sewer construction and paving.

PURCELLVILLE, VA.—The Loudoun El. & Ice Co., which is being organized, will take over the franchises recently obtained by E. A. Cockey, Jr., in the towns of Roundhill, Purcellville and Hamilton. It is proposed to build a combination electric, ice and cold-storage plant in Purcellville of sufficient size to supply the above-named towns and Lincoln, Bluemont and surrounding territory in Loudoun County. The company will be capitalized at $50,000, and the officers are E. A. Cookey Jr., Windsor Hills, Baltimore, Md., president; M. N. Lyon, vice-president, and J. W. Gregg, secretary and treasurer.

RADFORD, VA.—A syndicate composed of New York and English capitalists has secured an option on the property of the Old Dominion Pwr. Co., of Radford. The new company is contemplating large hydro-electric projects on the New River below Radford, the largest of which will be located at Hawk's Nest, Fayette County, where the Chesapeake and Ohio Railway crosses New River. The entire work will involve an expenditure of about $25,000,000 and about 350,000 hp will be developed, which will be transmitted to the coal fields in West Virginia and in southern Ohio. Transmission lines will extend as far west as Cincinnati and Columbus. Dr. J. J. Mott, of Statesville, N. C., is president of the Dominion Pwr. Co., and J. E. Walters, secretary and treasurer.

RICHMOND, VA.—The Richmond & Henrico Ry. Co. has applied to the City Council for a franchise to supply electricity for lamps and motors here.

MAPLE FALLS, WASH.—Smith, Kelly & Chace, of Toronto, Ont., Can., will begin work on the construction of a large power plant here at once. Work will be started at the same time on a similar plant in Bellingham. Right-of-way has been secured by the company for several electric railways and transmission lines.

SULTAN, WASH.—The proposition to install a municipal electric-light plant has been abandoned for the present. It is expected that a franchise will be granted to a private corporation to install a plant.

TONO, WASH.—The Washington Union Coal Co. is planning to construct a power plant here, to cost about $250,000.

WENATCHEE, WASH.—The Wenatchee Valley Ry. & Lt. & Pwr. Co. is reported to have sold $1,000,000 in bonds, to be used for the construction of an electric railway from Wenatchee to Leavenworth.

FAIRMONT, W. VA.—A project to build an electric railway to connect Pittsburgh and Fairmont and other towns with Wheeling has been revived. The West Penn Ry. Co. is interested in the plan and is said to have closed a deal at Uniontown, involving an expenditure of $172,000 for sites for terminal barns and freight offices, which are to be erected at once. It is proposed to extend the railway between Point Marion and Waynesburg to Connellsville and Uniontown and to connect them with Washington, Pa. From Washington the railway will connect with existing lines to Pittsburgh, while a branch from Washington is contemplated to West Alexander, Pa., to connect with railways now in operation into Wheeling.

BERLIN, WIS.—The City Council has appointed a committee to investigate the question of establishing a municipal electric-light plant in connection with the municipal water-works system.

CHIPPEWA FALLS, WIS.—The installation of new central heating and lighting plant for the municipal buildings has been recommended by the Board of Public Works. L. G. Arnold is city engineer.

LUXEMBOURG, WIS.—The installation of a lighting system to cost about $4,000 is under consideration.

SHOSHONI, WYO.—The Shoshoni Pwr. & Irrig. Co., Douglas, is planning to irrigate 20,000 acres. Power for operating the pumps will be supplied from the Boysen dam on Big Horn River. Plans and specifications for pumping station, transmissioin line and canal system are being prepared by the W. H. Rosecrans Engineering Co., 30 North La Salle Street, Chicago, Ill., which will have charge of the work.

EDMONTON, ALTA., CAN.—The by-law authorizing an issue of $1,800,000 in bonds for street-railway extensions, telephone extensions and improvements to the power plant has been approved by the ratepayers.

PORTAGE LA PRAIRIE, MAN., CAN.—The Great Falls Pwr. Co., Winnipeg, has submitted a proposition to the Council offering to erect a transmission line from Winnipeg to Portage La Prairie, provided the town will contract for 1000 hp for a term of 30 years. The company proposes to purchase electricity from the Winnipeg plant, to be transmitted at 60,000 volts and stepped down to 2300 volts.

WINNIPEG, MAN., CAN.—The Winnipeg El. Ry. Co. has decided to issue $3,000,000 additional capital stock.

HAMILTON, ONT., CAN.—The Hydroelectric Department has instructed E. I. Sifon, engineer, to prepare specifications for a year's supply of meters and transformers, bids for which will soon be called for.

LONDON, ONT., CAN.—The London St. Ry. Co. has decided not to use hydroelectric power and will build a steam-power plant, to cost from $50,000 to $75,000. C. B. King is manager.

LONDON, ONT., CAN.—Improvements and extensions are contemplated by the Water-works and Electrical Departments involving an expenditure of about $161,300. The report of the Electrical Department includes the proposed street lighting extension in the residential districts, to cost $31,700. The estimates submitted by the Water-works Department include an expenditure of $62,700 for additional equipment at Springbank and Horton Street pumping plants, for the lighting of Springbank Park, for main extension and for new workshop.

POINTE CLAIRE, QUE., CAN.—The Council has decided to install water-works, electric-lighting and drainage systems here. About $100,000 will be spent this year. The contracts for lighting and drainage systems have been awarded to Lorrain & Leitch.

ST. PACOME, QUE., CAN.—The River Ouelle Pulp & Lumber Co. would like to communicate with manufacturers in regard to furnishing a lighting plant for logging camps which it is planning to locate where water-power is not available. An electric generating plant is desired and one that can be operated without the services of a competent engineer on a storage battery.

NORTH BATTLEFORD, SASK., CAN.—Chipman & Powers, engineers, of Toronto and Winnipeg, have been engaged to prepare plans for enlarging the electric-light plant here.

New Industrial Companies.

THE CENTRAL LIGHTING FIXTURE COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $3,000 by Jacob E. Rosenfield, Edgar A. Wangersheim and Sydney Stein. The company proposes to manufacture and deal in gas and electric-lighting fixtures.

THE ELECTRIC HEAT-CONSERVING COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $250,000 by J. O. Dimmick, O. McGinnis and E. Olmstead.

THE ELECTRO-SANITATION COMPANY, EAST., INC., of New York, N. Y., has been granted a charter to manufacture sanitary and sewage-disposal apparatus. The company is capitalized at $100,000 and the incorporators are: C. F. Frothingham, J. C. Sparks and R. O. Butterfield, New York, N. Y.

THE INTERNATIONAL FUSE LIGHTER & ELECTRIC MANUFACTURING COMPANY, of Los Angeles, Cal., has been chartered with a capital stock of $1,000,000 by H. H. Mears, D. M. Potter, J. Auchell, W. W. Bearman and F. Fette.

THE KOERTING & MATHIESEN COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by Hans R. Boker, 101 Duane Street; Herbert Ryan, 355 Lenox Avenue, and James L. Suydam, 25 Broad Street, all of New York, N. Y. The company proposes to manufacture and deal in electrical supplies, etc.

THE RACINE ELECTRIC COMPANY, of Racine, Wis., has been incorporated with a capital stock of $3,000 to do a general electrical contracting business by Earl M. Crawford, Alfred I. Clifford and Earl O. Weatherford.

New Incorporations.

SAN FRANCISCO, CAL.—The Midland Counties Gas & El. Co. has been incorporated with a capital stock of $1,000,000. The directors are: William G. Crittenden, of Berkeley; William A. Nunlist, Joseph J. Webb and P. W. D. Webb, of San Francisco, and J. A. Williams, of Alameda.

SAN FRANCISCO, CAL.—The San Francisco Northern Ry. Co. has been chartered with a capital stock of $2,500,000 for the purpose of building an electric railway from San Quentin to Santa Rosa, a distance of 42 miles. The directors are: Allen I. Kittle, Ross; Archibald Borland, Oakland; William L. P. Jackson, San Francisco; Frank A. Brush, Santa Rosa, and John C. Kittle, Ross.

CHICAGO, ILL.—The Mount Greenwood & Worth Traction Co. has been incorporated with a capital stock of $10,000 by Jacob S. Hovland, Herbert W. Drew and John J. Poulton.

EAST ST. LOUIS, ILL.—The Chicago, Paducah & Thebes Ry. Co. has been chartered with a capital stock of $50,000 to build an electric railway from Streator to Brookport, with a branch to Thebes. The incorporators are: Clarence B. Long, Arthur M. Beckwith, Walter F. Beckwith, William R. Bryan and F. E. Boeckenroeger, all of East St. Louis.

HILLSBORO, ILL.—The Hillsboro Ry. Co. has been chartered with a capital stock of $50,000 by J. J. Frey, J. P. Brown and F. H. Brown to build and operate a street railway.

AUGUSTA, MAINE.—The Knox County Pwr. Co. has been incorporated with a capital stock of $5,000 for the purpose of supplying electricity in the towns of Union, Warren, Hope, Appleton and Washington in Knox County and Liberty, Searsmont and Montville, in Waldo County. The company will also furnish electricity to the Rockland, Thomaston & Camden St. Ry. Co. The incorporators are: S. S. Lancaster, E. E. Newbert, of Augusta, and O. M. Paine, of Hallowell.

PORTLAND, MAINE.—The Lisbon Falls El. Co. has been incorporated with a capital stock of $50,000. The officers are: A. F. Dunham, president; M. S. Wells, treasurer, and Frederick Hale, clerk, all of Portland, Maine.

JERSEY CITY, N. J.—The Hobart El. Co. has been incorporated with a capital stock of $50,000 to supply electricity for lamps, heat and motors. The incorporators are: Charles C. Chappelle, Charles K. Durbin and O. S. Moore, all of 60 Broadway, New York, N. Y.

KENMORE, N. Y.—The Interurban El. Lt. & Pwr. Co. has been incorporated with a capital stock of $50,000 to supply electricity in Kenmore and Tonawanda. The company has not yet decided where it will locate its power plant. The directors are: Frank W. Tracy, Albert Dodge and Alexander G. Hoefler, 296 Connecticut Street, Buffalo, N. Y.

BEAVER, OKLA.—The Beaver, Meade & Englewood R. R. Co. has been incorporated with a capital stock of $25,000 by Fred C. Tracy, John W. Webb, William T. Quinn, Levi S. Munsell and others of Beaver. The company proposes to build a railway from Beaver, Okla., to Meade and Englewood, Kan., a distance of 80 miles, to be operated by electricity, steam or gasoline.

CONEMAUGH, PA.—The East Taylor Lt., Ht. & Pwr. Co. has been granted a charter with a capital stock of $5,000. The directors are: C. B. Custer, of East Conemaugh, treasurer; Howard Davis and M. J. Davis, all of East Conemaugh.

Trade Publications.

WALL BANNER.—The Connecticut Shock Absorber Company, of Meriden, Conn., is distributing a handsome wall banner in six colors, measuring 22 in. by 28 in. This banner portrays a pretty girl and also gives an excellent illustration of the Connecticut shock absorber.

INSULATED WIRES AND CABLES.—The Safety Insulated Wire & Cable Company, New York, has issued an interesting booklet on the ethics of wire making, in which those features which differentiate its product from others on the market are pointed out and some manufacturing details given in order to emphasize the care exercised at every step in making of rubber-covered wires and cable of superior quality.

TELEPHONE APPARATUS.—Bulletin No. 3 of the Lafayette Electric & Manufacturing Company, Lafayette, Ind., illustrates and describes the Sterling can-top terminals, protectors and arresters for all classes of telephone service. The company has a terminal and protector for every use, and the devices shown constitute a collection of the various types of this class of apparatus demanded by approved standard telephone practice.

WATER TURBINES.—The Trump Manufacturing Company, Springfield, Ohio, has issued its 1912 catalog of well-known turbine waterwheels. A number of the many types of wheels manufactured by the company are illustrated, as well as cross-sectional and photographic representations of typical installations. Tables giving power and speed of the company's standard and high-head wheels are included, together with tables showing the discharge of water under various heads and the amount of water that will pass through a weir-board per minute.

INSTITUTE OF INDUSTRIAL RESEARCH.—The Institute of Industrial Research, Washington, D. C., has issued a well-printed pamphlet presenting the plan and scope of the organization, giving professional sketches of the principal members of the staff and showing views of some of the laboratories. The work of the institute consists in the investigation and improvement of industrial processes, particularly those relating to paint technology, electrical engineering and electrochemistry, and in instituting economies and improvements in the manufacture of fertilizers and general chemicals.

THE TRIUMPH CHRONICLE.—The first number of a house organ with the name *The Triumph Chronicle*, published in the interests of the Triumph Electric Company and of the Triumph Ice Machine Company, both of Cincinnati, Ohio, has made its appearance. Its keynote is co-operation and its object is to foster a co-operative spirit between the branches, salesmen and agents of the companies throughout the country. Naturally the publication is partial to Triumph products, and the issue contains, besides descriptions of electrical and refrigerating apparatus, notes from the field and from the home office.

ELECTRICAL INSTRUMENTS.—Catalog No. 15, issued by the Keystone Electrical Instrument Company, Philadelphia, Pa., describes and illustrates the company's indicating and recording instruments for either direct-current or alternating-current circuits. The company's direct-current instruments are of the D'Arsonval type, while its alternating-current instruments are designed on the electrodynamometer and electromagnetic systems. The make-up of the instrument and the principles on which they are built are fully illustrated and described. The catalog, which contains 88 pages, also contains the usual tables, price lists and dimensional diagrams.

RECORDING INSTRUMENTS.—Bulletin 102, entitled "Uehling Recording Instruments," just issued by the Uehling Instrument Company, of Passaic, N. J., covers in condensed form that company's various types of recorders and the standard charts for use in connection with these instruments. The catalog describes a line of recorders for pressures up to 30 lb. per square inch, calibrated either in ounces, pounds, inches of water or mercury, and also recorders for light pressures and vacuums in inches of water, draft and differential-draft gages calibrated in inches of mercury, revolution recorders, etc. All of these instruments operate on a hydrostatic principle by the application of which springs, lever and joint movements are avoided.

Business Notes.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, 180 West Lake Street, Chicago, has engaged as its secretary Mr. E. W. McClelland, who was formerly manager of the supply department of an electrical supply house in the Northwest.

THE WHEELER CONDENSER & ENGINEERING COMPANY, of Carteret, N. J., manufacturer of surface and jet condensers, pumps, cooling towers, etc., announces that its Cincinnati office has been moved from the Ingalls Building to the Mercantile Library Building of the same city. The new office will be in charge of Mr. Richard L. Strobridge, who was formerly connected with the Boston office of the Wheeler Condenser & Engineering Company.

THE SIDLEY-MITCHELL ILLUMINATING COMPANY, of 221 South Clinton Street, Chicago, has been formed as the successor of the Thomas H. Sidley Company. The company handles the Sidlite Mazda lighting unit, various types of fixtures for window lighting and interior illumination and electric signs. It does some manufacturing and is also

agent in Chicago for the Scott flaming-arc lamp. Mr. Thomas H. Sidley is a brother of Mr. William P. Sidley, vice-president of the Western Electric Company, and was himself connected with that company formerly. Mr. Karl M. Mitchell, the recruit in the organization, has been connected with the Chicago Telephone Company until recently.

NEW SELLING ARRANGEMENTS FOR EXCELLO FLAMING ARC LAMPS AND CARBONS.—The Koerting & Mathiesen Company, sole manufacturer of Excello flaming-arc lamps and Excello flaming carbons, announces that both the lamp and carbons will hereafter be marketed exclusively by Koerting & Mathiesen, Inc., with George W. Armstrong as general manager. Headquarters have been established at 22 East Twenty-first Street, New York, N. Y. The parent company has been manufacturing Excello arc lamps for the last ten years and through its technical director and its organization has developed a highly efficient and economical flaming-arc lamp, of which the output has been more than 60,000 annually. Mr. Armstrong, who becomes general manager of the company, has been one of the most active and enterprising exponents of the flaming-arc lamp in this country and for years was Western manager of the Excello Arc Lamp Company of New York. Mr. Armstrong is a native of Ohio and began his business career in that State. He established his first connection with the flaming-arc industry in 1906, opening the office of district manager of the Excello Arc Lamp Company in Columbus, Ohio. He was at that time salesman and agency organizer of the company, and in February, 1908, went to Chicago for the company to establish the Western office, which immediately developed a large business. Mr. Armstrong will make his headquarters at the head office in New York and will be assisted by a strong organization of illumination experts.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 13, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,016,925. OUTER BOX; A. I. Appleton, Chicago, Ill. App. filed Aug. 21, 1909. Sections secured together by slotted lugs and screws.

1,016,936. ELECTRICAL BURGLAR ALARM; W. K. Cook, Minneapolis, Minn. App. filed Aug. 9, 1909. For bank vaults, etc.

1,016,975. BLOCK SIGNAL SYSTEM FOR ELECTRIC RAILWAYS; S. S. Stolp, Chicago, Ill. App. filed Sept. 4, 1908. To protect intersecting tracks in tunnels, etc.

1,016,980. CONTROLLING DEVICE FOR ELECTRIC-MOTOR VEHICLES; E. W. Bender, Los Angeles, Cal. App. filed July 13, 1910. Direct-current motor-generator and alternating-current motor.

1,017,005. ELECTRODE OR PENCIL FOR THE ARC LIGHT; I. Ladoff, Cleveland, Ohio. App. filed May 14, 1906. Titanium alloy with potassium fluotitanate.

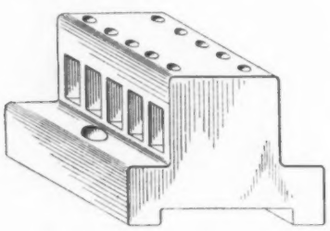
1,017,034. TROLLEY HARP; T. Bednarowicz, South Bend, Ind. App. filed Nov. 21, 1910. Contacts and guards.

1,017,036. WIRING TACK; C. C. Blake, Brookline, Mass. App. filed Sept. 18, 1911. Single point with two arms.

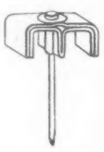
1,017,051. LAMP SOCKET; J. H. Hall, Sulphur Springs, Tex. App. filed Aug. 14, 1911. Has a resistance coil for varying the luminosity.

1,017,052. SYSTEM OF ELECTRIC-CIRCUIT CONTROL; F. W. Harris, Wilkinsburg, Pa. App. filed March 9, 1908. Automatic circuit-breaker with remote control.

1,017,054. TELEGRAPH SENDING MACHINE; J. A. Hulit, Topeka, Kan. App. filed Nov. 6, 1909. Automatic current controller driven by a spring motor.



1,017,172—Advertising and Signaling Device.



1,017,036.—Wiring Tack.

1,017,060. SYSTEM OF ELECTRIC CURRENT DISTRIBUTION; C. M. Moss and S. Q. Hayes, Pittsburgh, Pa. App. filed May 13, 1909. The circuit interrupter is controlled by remote means.

1,017,064. GALVANIC BATTERY; E. C. Smith and E. L. Marshall, Fremont, Ohio. App. filed Aug. 7, 1909. Caustic-solution battery for automatic railroad block-signal systems, etc.

1,017,071. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; J. Bache-Wiig, Edgewood Park, Pa. App. filed May 22, 1911. Cross-connections between the windings.

1,017,080. SECONDARY OR STORAGE BATTERY; J. P. Clare, Stratham, N. H. App. filed Sept. 23, 1910. The plates have abrupt edges to prevent creeping.

1,017,085. TELEPHONE SYSTEM; F. M. Davis, Chicago, Ill. App. filed March 29, 1909. Two-wire multiple-line circuit for local battery lines to operate on a common-battery cord circuit.

1,017,101. AUTOMATIC BELL SWITCH; A. D. Kaiser, Detroit, Mich. App. filed May 29, 1909. For a door alarm, etc.

1,017,110. LOCK FOR ELECTRIC PLUGS; E. E. Rogers, London, England. App. filed Feb. 16, 1911. Safety device for mine-lighting system.

1,017,122. ELECTRIC LOCOMOTIVE; J. E. Webster, Pittsburgh, Pa. App. filed June 20, 1910.

1,017,150. CONTROLLER FOR ELECTRIC CRANES; E. N. Holme, Stockport, England. App. filed Oct. 29, 1909. Portable controller for cranes, loading ships, etc.

1,017,169. METHOD OF AND APPARATUS FOR TRANSMITTING SIGNALS OVER TELEGRAPHIC CIRCUITS; L. M. Potts, Baltimore, Md. App. filed Jan. 25, 1908. Synchronously transmitting and repeating; reversed-wave method.

1,017,172. ELECTRIC ADVERTISING AND SIGNALING DEVICE; W. S. Ryan, New York, N. Y. App. filed July 11, 1911. Porcelain block with brushes.

1,017,198. ELECTRIC-MOTOR VEHICLES; E. W. Bender, Los Angeles, Cal. App. filed July 13, 1910. Storage battery with a direct-current motor-generator and alternating-current motor-converter.

1,017,226. DEVICE FOR INDICATING THE INTENDED MOVEMENTS OF VEHICLES; G. S. Matthews, Kansas City, Mo. App. filed Nov. 29, 1910. Red and green lights with a switch on the steering wheel.

1,017,246. AUTOMATIC STARTER FOR ELECTRIC MOTORS; J. B. Calderwood, Milwaukee, Wis. App. filed Dec. 30, 1904. Successive switches.

1,017,257. SYSTEM OF MOTOR CONTROL; B. Frankenfield, Norwood, Ohio. App. filed, Jan. 31, 1907. A main motor is ventilated by an auxiliary motor.

1,017,258. OZONIZING APPARATUS; M. Fuss, Berlin, Germany. App. filed Feb. 16, 1911. The condenser surrounds the high-tension coil of the transformer.

1,017,260. ELECTRIC-LAMP SOCKET; J. H. Goehst, Chicago, Ill. App. filed Nov. 7, 1910. Waterproof socket.

1,017,263. ELECTRIC ILLUMINATION; I. Kitsee, Philadelphia, Pa. App. filed Feb. 8, 1909. The filament holder is shaped like a letter, etc.; for signs, etc.

1,017,270. MOTOR-CONTROL SYSTEM; E. W. Stull, Milwaukee, Wis. App. filed Aug. 1, 1910. Bridge method of series-parallel control.

1,017,285. RAIL BOND; J. T. Deviese, Hilltop, W. Va. App. filed May 31, 1911. Bolts and a flexible bond.

1,017,308. LIGHTNING CONDUCTOR; M. G. Mitchell, South Bend, Ind. App. filed April 22, 1909. Adjustable support for a hollow distributor point.

1,017,309. BRUSH HOLDER; S. H. Mortensen, Milwaukee, Wis. App. filed April 15, 1909. Rigid support on direct-current turbo-generator, etc.

1,017,348. REACTANCE COIL; T. E. Murray and P. Torchio, New York, N. Y. App. filed May 19, 1911. Flat spiral coil.

1,017,362. SANITARY PROTECTOR FOR TELEPHONE TRANSMITTERS; C. Adams, New York, N. Y. App. filed March 14, 1911. Shield for the mouthpiece.

1,017,398. TELEGRAPH KEY; J. E. Folsom, St. Louis, Mo. App. filed Jan. 16, 1911. Grasping the key opens the circuit.

1,017,413. ELECTRIC CONTROLLER; J. P. Hayes, Pittsburgh, Pa. App. filed June 11, 1907. Reciprocating motor (like Patent No. 869,780) operates the controller.

1,017,462. FROG FOR TROLLEYS; J. M. Premoshis, Forbes Road, Pa. App. filed Aug. 26, 1911. For switching a trolley wheel.

1,017,483. PROCESS OF MAKING MOLDED CONDUCTORS; C. Van Brunt, Schenectady, N. Y. App. filed March 23, 1910. Carbonaceous material, pitch and sulphur are fired to carbonize the pitch.

1,017,497. ARC-LIGHT ELECTRODE; E. R. Berry, Lynn, Mass. App. filed Aug. 6, 1909. Titanium carbide and chromium carbide as a restrainer.

1,017,510. ELECTRIC MOTOR; F. W. Casterline, Tipton, Ia. App. filed Jan. 9, 1911. The field and armature are both rotatable.

1,017,513. ELECTRIC-ALARM MAIL BOX; J. H. Corbett, Jr., Syracuse, N. Y. App. filed Aug. 10, 1910. An introduction of mail matter closes the alarm circuit.

1,017,527. ELECTRIC-LINE SWITCH; F. Fisher, Reardan, Wash. App. filed Dec. 1, 1909. For trolley lines and power transmission, etc.

1,017,546. FILAMENT SUPPORT; J. W. Howell, Newark, N. J. App. filed Dec. 28, 1906. Yielding support for tantalum filaments, etc.

1,017,597. MAGNETO; J. E. Seeley, Los Angeles, Cal. App. filed Jan. 31, 1911. For ignition system for gas engines.

1,017,604. CIRCUIT CLOSER; V. Tardieu, Arles, France. App. filed July 25, 1907. Call-push device for telephones.

1,017,614. TRAVELING CONTACT FOR ELEVATORS; S. S. Williamson and B. Wilson, Philadelphia, Pa. App. filed Dec. 31, 1901. A guide slot and pressure device.

1,017,616. TELEPHONE REPEATING APPARATUS AND CIRCUITS; C. Adams-Randall, New York, N. Y. App. filed March 13, 1911. Toll-line apparatus.

1,017,617. APPARATUS FOR INCREASING THE EFFICIENCY OF TELEPHONE LINES; C. Adams-Randall, New York, N. Y. App. filed March 13, 1911. Repeating apparatus.

1,017,634. MEANS FOR PROTECTING ELECTRICAL INSTALLATIONS FROM EXCESS VOLTAGES; G. Campos, Milan, Italy. App. filed Aug. 19, 1910. Devices in series in the line for producing induction adjacent thereto.

1,017,641. ARC LAMP; T. L. Carbone, Charlottenburg, Germany. App. filed Feb. 21, 1910. The glide has an annular condensing chamber.